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THE ORIGINAL MAGAZINE FOR TRS-80™* OWNERS

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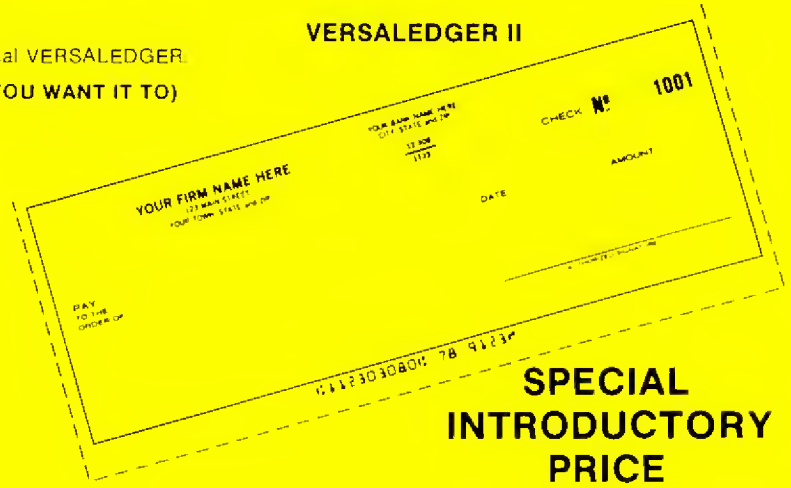

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SEPTEMBER 1982 **ISSUE NUMBER 49**

CONTENTS

FEATURES

14 Program Previews ..... A. A. Wicks
This Month: The Custom TRS-80 by Dennis Bathory Kitsz

16 Array of Hope for Basic Programmers ..... Arne Rohde
First of a new series

20 Program Conversion (Part VIII) ..... Richard Kaplan
Non-Microsoft BASIC

26 Practical Business Programs ..... S. M. Zimmerman and L. M. Conrad
A Program for the Simplex Method of Linear Programming

33 Hardware Reviews ..... Joseph Rosenman
The EPSON Graftrax

47 Records and Files ..... Gordon Speer
Using sequential and random files

50 Monthly Expenditure Information Package ..... Bill O'Neill
Keep track of your monthly expenses

53 Pregnancy and the Computer ..... Bob Krotts
How to cope

54 Assembly Language for Beginners (Part 7) ..... Joseph Rosenman
Introduction to assembler directives

57 Scramble ..... Frank S. Kasper
Scramble or unscramble jumbled words

58 Z80 Reference Guide ..... Joseph Rosenman
A Z80 instruction reference table

REGULAR DEPARTMENTS

2 Bits and Pieces ..... Howard Y. Gosman
Publisher's Remarks

4 The Crystal Ball
News and rumors of interest to TRS-80 owners

10 Letters to the Editor
Readers tell us what's on their minds

38 Beginner's Corner: Book Review ..... Spencer Koenig
Intermediate Programming for the TRS-80 by David L. Heiserman

40 Color Computer Corner ..... Joseph Rosenman
This Month: Spectaculator and Space War

42 Pocket Computer Corner ..... S. M. Zimmerman and L. M. Conrad
This Month: A General Ledger Program for the Pocket Computer

68 Advertising Directory

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BITS AND PIECES

Howard Y. Gosman

COMPUTRONICS CLASSIFIEDS

There will soon be a new section in the Computronics magazine. The November issue will probably be the first issue to include our new Computronics Classified section. Suggestions from readers have led us to the conclusion that a classified ad section would provide a useful service to those who want to reach the largest number of TRS-80 users with their messages, at an affordable price. The introductory rates (which are 50% less than the basic rates) for a message of up to 25 words will be $20 for a single placement, $15 per month when placed in three issues, $12 per month when placed in six issues, and $10 per month for placements in 12 issues.

To place your ad, enclose full payment by check or money order (Visa, Master Card, and American Express are accepted, also) to H & E Computronics, Inc. 50 North Pascack Road, Spring Valley, NY 10977.

For additional information and costs for ads in excess of 25 words, please call Kevin Rushalko at (603) 547-2970. These introductory rates may be withdrawn at any time. However, payments received will guarantee these introductory rates for the number of issues paid for even if there are rate increases in the interim.

THE APPLE MYSTERY

A reader recently pointed out an amusing fact about our June cover photo:

"I subscribe to your magazine, and I enjoy reading it very much!
I have one question for you:
Why is there an *APPLE* logo on the front cover of the June issue?"

Well, we never knew it until we

continued on page 4

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The H & E COMPUTRONICS MONTHLY NEWS MAGAZINE encourages comments, questions, and suggestions. H & E COMPUTRONICS will pay contributors for articles and programs published in the magazine.

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THE CRYSTAL BALL

(News and Rumors of Interest to TRS-80 Owners)

NEW PRODUCTS FROM RADIO SHACK

The National Computer Conference in Houston was the atmosphere chosen by Radio Shack to announce several new products (as described in the July 5th *InfoWorld*).

Radio Shack has unveiled its new PT-210 Portable Data Terminal, which is a briefcase-sized machine designed to pass data to and from a computer over telephone lines. With its low-profile design, the PT-210 is similar in appearance to the Texas Instruments Silent 700 terminals. Priced at $995, the terminal houses its own thermal printer and a 110/300 baud Bell 102A compatible acoustic coupler. This is not a computer—it has no off-line memory or software features. But it is a very portable tool (weighs 15 lbs.) and it can be easily integrated into systems that require remote data entry and retrieval, This terminal will probably be a strong competitor in its field, provided that portable *computers* (like the Osborne 1) don't steal the entire market for remote terminals.

Radio Shack will also be producing a 16K version of the Color Computer that will sell for $399.95 (the 4K version will continue to be sold, at a reduced price of $299).

They've also announced a new color graphics printer that will sell for $249.95. The printer will produce text and graphics in four colors, on roll paper 4.5 inches wide, and gives a choice of 40 or 80 characters per line when printing text. The print speed is 12 characters per second, and the printer comes equipped with both serial and parallel interfaces.

The new TRS-80 DC-1200 High Speed Direct Connect Modem was also presented at the show—it will be priced at $699, with an optional auto-dialer available for $149.95. The new modem will operate at speeds from 0-300 or 1200 baud.

NEW DISK BACKUP PROGRAM

Data Associates have released a program called REBACKUP, which they say will allow you to make copies of protected software such as VISICALC and SCRIPSIT. The manufacturers hasten to point out that protected programs such as these, which allow you to make only *one* backup copy for safe keeping, will eventually force you to purchase a replacement disk when both of your copies finally go bad. The expense and delay involved in sending for a replacement can only be avoided if you have a method of making unlimited backup copies of needed software. REBACKUP, priced as $24, is supplied as a Disk Basic program on cassette, and it contains built-in prompting instructions (at least one disk drive is required). You can contact Data Associates by writing to P.O. Box 882, Framingham, MA 01701. The copying of protected software is a subject of continuing controversy, but the manufacturer maintains that making extra copies of important software for your own use and protection is a procedure that is both legal and wise.

VERBATIM WARRANTY

Verbatim must be very sure of the quality of its diskettes, because they have announced a *FIVE-YEAR WAR RANTY* on all of their DATALIFE diskettes. Effective immediately, all diskettes ever sold under the DATALIFE label will be covered by this warranty. Many people do think that Verbatim makes the best diskettes—and the people at Verbatim probably don't think they will have to replace a lot of disks. ■

BITS AND PIECES

continued from page 2

read this letter, but there was an Apple logo stuck to the paymaster's window shown on the June cover.

This gives us a good opportunity to point out, for those of you who don't already know, that although H & E Computronics concentrates almost exclusively on *TRS-80* computers in this magazine, we also develop and sell software for Apple, IBM, Atari,

continued on page 6

A Sweet Deal...

Buy an Alpha Joystick and games together and deduct up to $14.00 from your order.

(Model I version shown)

The Alpha Joystick adds arcade-style control to TRS-80 action games. Simply plug it in and begin playing joystick compatible games. No modification, wiring or batteries are required, and the Alpha Joystick is compatible with other TRS-80 accessories. The instructions are clear and complete. We even show how easy it is to experiment in BASIC (A=INP(0) reads stick) and convert BASIC programs to Joystick control.

MODEL I - Plugs directly into any Level II Keyboard (card edge on rear) or expansion interface (left side, next to printer port).

MODEL III - Works with any 'Model III BASIC' system and plugs into the 50 pin I/O bus (largest edge connector underneath).

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Joystick + 1 game Deduct $ 6.00
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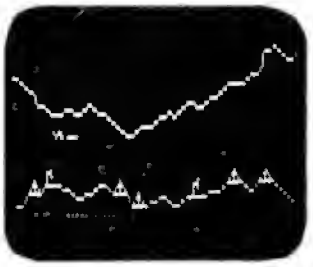
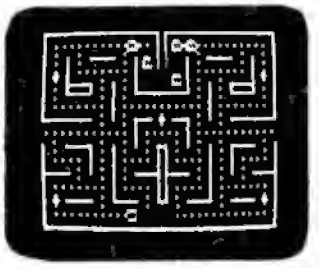
Choose from any of the Joystick Compatible games below. Be sure to mention the "Sweet Deal" discount when ordering.



PENETRATOR

Soar swiftly over jagged landscape, swooping high and low to avoid obstacles and enemy missile attacks. With miles of wild terrain and tunnels to penetrate, you're well armed with bombs and multiple forward missile capability. From Melbourne House. Features sound, trainer mode and customizing program.



• • SCARFMAN

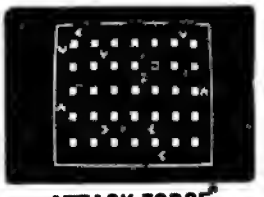
This incredibly popular game craze now runs on your TRS-80! It's eat or be eaten. You control Scarfman around the maze, gobbling up everything in your path. Try to eat it all before nasty monsters devour you. Excellent high speed machine language action game from the Cornsoft Group. With sound.

SUPER NOVA®

Asteroids float ominously around the screen. You must destroy the asteroids before they destroy you! (Big asteroids break into little ones.) Your ship will respond to thrust, rotate, hyperspace and fire. Watch out for that saucer with the laser! As reviewed in May 1981 Byte Magazine.

LUNAR LANDER

As a vast panorama moonscape scrolls by, select one of many landing sights. The more perilous the spot, the more points scored — if you can land safely. You control LEM main engines and side thrusters. Absolutely the best use of TRS-80 graphics we have ever seen! From Adventure International. With sound.



ATTACK FORCE®

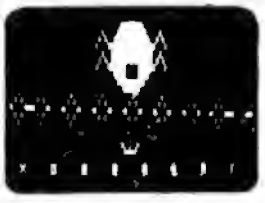
As your ship appears on the bottom of the maze, eight alien ships appear on the top, all traveling directly at you! You move toward them and fire missiles. But the more aliens you destroy, the faster the remaining ones become. If you get too good, you must endure the "Flagship". With sound effects!

COSMIC FIGHTER®

Your ship comes out of hyperspace under a convoy of aliens. You destroy every one. But another set appears. These seem more intelligent. You eliminate them, too. Your fuel supply is diminishing. You must destroy two more sets before you can dock. The space station is now on your scanner. With sound!

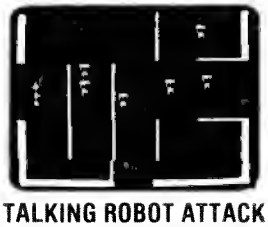
GALAXY INVASION

The sound of the klaxon is calling you! Invaders have been spotted warping toward Earth. You shift right and left as you fire your lasers. A few break formation and fly straight at you. You place your finger on the fire button knowing that this shot must connect! With sound effects!



DEFENSE COMMAND

The invaders are back! Alone, you defend the all important nuclear fuel canisters from thieving aliens who attack repeatedly. An alien passes your guard, snatches up a cannister and flys straight off. Quick! You have one last chance to blast him out of the sky! With sound and voice.



TALKING ROBOT ATTACK

This game TALKS without a voice synthesizer, through the cassette port. With just a hand laser in a remote section of the space station, you encounter armed robots. Some march towards you, more wait around corners. Careful, the wallas are electrified. Zap as many robots as you dare before escaping to a new section. More robots await you.

ARMORED PATROL

A realistic tank battle simulation. Your view is a 3—D perspective of an alien landscape. Manuever your T-36 tank to locate and destroy enemy tanks and robots that lay hidden, ready to assault you. Clever graphics create the illusion of movement and dimension. From Adventure International. With sound.

GAME PRICES

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These games are "Alpha Joystick Compatible." They may be played with or without Joystick (using arrow keys).

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BITS AND PIECES

continued from page 4

and Pet computers. We believe that the most successful software will be the software that can run on *many* different systems, but appear the same to the user regardless of the type of machine used. Although we developed all of our programs for TRS-80 computers, we have been hard at work developing versions converted for these other machines. One additional result of this work is our growing experience with translations from one dialect of BASIC to another, which, in the case of the ATARI and PET computers, is a difficult translation indeed. Richard Kaplan gives the details of these translation procedures in his continuing column, "Program Conversion."

VERSAINVENTORY

The task of inventory maintenance is a complex one. The ultimate goal of the system is to keep track of every single item that is presently in stock, what is being sold and taken from stock, what items have fallen to a predetermined level and should be reordered, what items have actually gone out of stock, and what has been placed on backorder. To accomplish these tasks, an inventory program must be able to:

—store and retrieve complete records of current in-stock and out-of-stock items, including Name of item, Price, Vendor information, Sales statistics, etc.

—provide simple methods for entering new stock items into the files

—search through files, display records, and print finished reports from data in the files

—allow easy updating of stock levels (as items are received and sold) and alteration of prices and other information

—print invoices if desired, or interface with an ACCOUNTS RECEIVABLE program to deduct from inventory levels automatically

—guide even the totally uninitiated computer user step-by-step through power-up, proper diskette handling and backup procedures, and provide for the quick training of those who will use the program (all with the help of a good manual).

VERSAINVENTORY is the latest in a series of Computronics Business programs, and it has arrived in the offices of a lot of customers this past month. So far, everyone has been more than pleased with it. *(We should take time to say that the credit for this goes to Nancy Rhodes, the author of* VERSAINVENTORY, *and also author of our* VERSAPAYROLL, VERSARECEIVABLES, *and* VERSAPAYABLES *programs.)*

When a user powers up *VERSAINVENTORY,* the first things that must be accomplished are the creation of one or more backup copies of the program diskette(s) and the creation of a blank formatted Data diskette.

When the program is run, the MAIN MENU appears, which presents the user with these choices:

INITIALIZE SYSTEM
ADD/UPDATE MASTER INVENTORY FILE
SORT FILE
ZERO YEAR-TO-DATE AND PERIOD-TO-DATE TOTALS
CHANGE MASTER FILE SIZE
SALES/RETURNS
RECEIPT OF INVENTORY
INVOICING
PRINT REPORTS

A pointer at the left of the list of options can be moved up and down with the arrow keys, and when you press <ENTER>, the indicated subprogram or function is run. Explanations of each of these options follow.

Initialize System

New users will be directed to choose this item first. The Initialization of your system includes:

—the specification of the number of disk drives attached and the maximum number of items to be in the Master Inventory File (these parameters can be altered later, if desired)

—the entry of your company's address (to be used on reports)

Add/Update Master Inventory File

Whether you select this item directly, or select Zero Year-to-Date and Period-to-Date Totals, you will arrive at the ADD/EDIT MENU which presents an additional list of options:

ADD ITEMS TO INVENTORY
UPDATE ITEM IN INVENTORY
DELETE ITEM FROM INVENTORY
SORT INDEX FILE
ZERO PERIOD-TO-DATE TOTALS
ZERO YEAR-TO-DATE TOTALS
RETURN TO MAIN MENU
QUIT

ADD ITEMS TO INVENTORY You will be systematically asked for each piece of information necessary to create an inventory item record, and only data that fits the specified format for each field will be accepted by the program. The following information is asked for by the

program:

Item Identification: A twelve character identification code. This number will determine the location of this item's record in the Master Inventory File, and you must refer to this number later to retrieve and update the record again.

Description: A twenty character description of the item.

Vendor's Item No.: A twelve character item identification number. This will be your supplier's *own* identification code for the item, and will be useful when filling out a purchase order.

Vendor ID.: A six character code that identifies the Vendor.

Department: A six character department I.D.

Location: A two character code for locating the item in stock. Can be used to create picking lists.

Units: A three character code to identify units of sale—for example, items sold in pounds could be coded "LBS" and items to be sold individually could be coded "EAC" (each).

Weight: A five character code for weight. You can express the weight of an item in any way—the figure is not used in any calculations, it is purely for your use on reports or invoices.

Last P.O. #: A six character figure—the last purchase order issued for this item.

Last P.O. Date: An eight character field holding the date of the last purchase order issued for this item.

Delivery Data: An eight character field containing the expected date of delivery for the purchase made on the most recent purchase order.

Items in Stock: The quantity of this item in currently in stock.

Number On Order: The number of items whose arrival you are currently anticipating. Whenever a purchase order is made or shipment received, this value is updated accordingly.

Number On Backorder: The number of items that are currently on order by your customers, to be immediately delivered upon replenishment of stock.

Reorder Level: When stock drops to this level, this item will be automatically placed on a reorder report.

Reorder Quantity: The number of items that are customarily ordered to maintain a satisfactory level of stock. When the reorder report is printed, this value is printed as the standard number of items to be ordered, and a second reorder quantity es printed that takes into account the actual number of items in stock, the number already on order, and the number on backorder.

Items Sold Period-to-Date: The number of units of this item that have been sold since the beginning of the current period. The start and duration of the period is arbitrary, and depends on you and your company. Whenever an item is sold or returned, this number is updated.

Items Sold Year-to-Date: The number of units of this item that have been sold during your current fiscal year. Whenever an item is sold or returned, this number is updated.

Latest Cost: The most recent price paid to the vendor per unit of this item.

Average Cost: If you have no average cost for this item, you just enter the latest cost, then the program will compute the average cost each time there is a change.

Selling Price: This is your standard price for a single unit of the item. When you make a sale, this value is the price that the program will use unless you specify otherwise.

Alternate Price: A second price for the item. This value is used only for your reference, and seen only when printing an inventory price list.

Sales Period-to-Date: The dollar amount of items sold in the present period. This value is updated automatically by the program.

Sales Year-to-Date: The dollar amount of items sold in the current year. This value is also updated automatically by the program.

After entering information for an item, you will see it all displayed on the screen, so that you can check for errors. If you wish, you may make corrections, then the record will be stored on your Data Diskette. While storing the record, the program checks the Item Identification code to make sure that this code does not already exist in the file. If an item is already using that code, you may choose to change the code and then store the record, or over-write (destroy) the record that already

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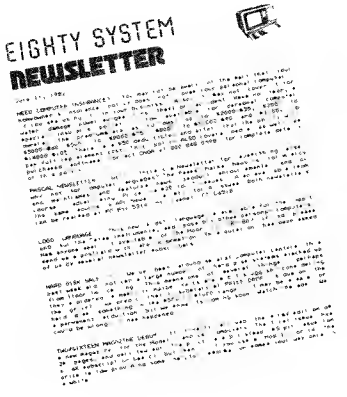

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exists at that location.

Once you have added new items to the inventory file, you must use the SORT FILE option in the MAIN MENU before printing reports, so that new items will be included.

UPDATE ITEM IN INVENTORY Selection of this option allows you to change any piece of information on any record in the inventory file. While there are some fields that you will undoubtedly find reason to change from time to time, there are other fields which should rarely, or never need changes. For example, the purchase order number, delivery date, Vendor I.D., Vendor's item number, etc., are all items which you might expect to change once in a while. On the other hand, fields like total items sold, or total sales, you should never need to change.

Once you select this option, you will be asked the item's identification code. The program will locate the item record, and display it on screen, along with the question "CHANGE WHICH FIELD?" Each field is numbered (1-24), and you just enter the number of the field you wish to alter. Next, you will be asked "NEW VALUE?" Now you just type in the correct value for this field. If the new value does not conform to the format of the particular field, it will not be accepted, and you will have to retype it.

If, in the process of editing, you should happen to change the Item Identification code, then the program will move the record to a new location in the file according to the code you use.

Sort File

Your inventory file can be sorted and printed out according to several fields in the record. Each time you need a sorted listing, you must use this option to choose the order into which the list will be sorted.

Upon selecting this option, you are presented with this list of fields:

ITEM IDENTIFICATION
DESCRIPTION
VENDOR'S ITEM NUMBER
VENDOR I.D.
DEPARTMENT
LOCATION

The file will be sorted alphabetically or numerically, according to the field you choose.

Zero Period-to-Date Totals

This procedure should be run after all the end-of-period reports have been printed. The "Items Sold Period-to-Date" and "Sales Period-to-Date" fields will be affected by this procedure.

Zero Year-to-Date Totals

This procedure is run after all of the end-of-year reports have been printed. The "Items Sold Year-to-Date" and "Sales Year-to-Date" fields will be affected by this procedure.

Change Master File Size

This option will run an auxilliary program that will allow you to change the size of your file. The basic procedure is to create a temporary diskette that holds the new master file, then copy the new file back to the master Data diskette. Changing the size of your file will have no visible effects other than to increase capacity (if file is enlarged) or to increase speed (if file is reduced).

Inventory Activity

This is the portion of the program which will allow you to report your selling and purchasing activity and generate invoices. When you select "Sales/Returns", "Receipt of Inventory", or "Invoicing" from the MAIN MENU, you are presented with this list of options:

SALES
RECEIPT OF INVENTORY
RETURNS
PREPARE INVOICES
RETURN TO MAIN MENU
QUIT

If you wish to enter sales activity, receipt of inventory, or returns, you will be asked if you wish a printed "Change Report". If you agree, you will be prompted for the date, and then every time you make a change to the inventory file, the change is printed out, along with other pertinent information concerning the item.

SALES—This option is for entering the sales that have been made since the last time you reported sales. The first thing the program will ask is the item identification number, then, after finding the correct record, it will display that record's data, and ask you how many units were sold. If the number of items sold is greater than the number of items in stock, a message will appear on screen alerting the operator and informing how many of the items in the order can be delivered and how many must be placed on backorder. The computer will wait for verification that you do want to place the extra items on backorder, or you can alter the figure for the number of items being sold. After you have responded to these queries, the screen will display the updated information and the computed total sales for this transaction. The program will ask you if all is correct before proceeding to update the master file. The following items are updated by this procedure:

—ITEMS IN STOCK is decreased by the number of items sold.

—If the number of items sold is greater than the number in stock, then the NUMBER ON BACKORDER is increased by the number of items that could not be provided for this sale.

—ITEMS SOLD PERIOD-TO-DATE and ITEMS SOLD YEAR-TO-DATE are increased by the number of items sold.

—SALES PERIOD-TO-DATE and SALES YEAR-TO-DATE are both increased by the total amount of this transaction.

RECEIPT OF INVENTORY This option is for entering a newly arrived shipment of goods to the records. The first thing you will be asked is the item's identification number.

Once the program has found the correct record, some of the record's pertinent data will be displayed, and you will be asked to enter the number of items received, and the latest cost (if different from previous cost).

The new information will be displayed for your approval before the updated record is written to the disk. The following items are altered by this procedure:

—ITEMS IN STOCK is increased by the number received.

—If there were any items on backorder, they are taken off backorder, and the ITEMS IN STOCK is decreased by the number of items taken off backorder.

—The NUMBER ON ORDER is decreased by the number received.

—The LATEST COST is updated if the cost of this shipment is different from that of the last shipment.

—If the LATEST COST has been changed, then the AVERAGE COST is re-calculated based on the number of items in stock before the shipment, valued at the old AVERAGE COST, and the number of items purchased based on the new LATEST COST.

RETURNS This option is for reporting returned merchandise that is coming back into inventory from a customer. The program will recall the correct record, and allow you to enter the number of items that are being returned. The following items are updated by this procedure:

—ITEMS IN STOCK is increased by the number of items returned.

—ITEMS SOLD PERIOD-TO-DATE and ITEMS SOLD YEAR-TO-DATE are decreased by the number returned.

—SALES PERIOD-TO-DATE and SALES YEAR-TO-DATE are reduced by the number of items returned.

PREPARE INVOICES This option allows you to prepare and print out invoices, and will record the changes to inventory. You may include up to eight different items on each invoice, and each item's record is recalled and displayed as you are asked the number sold (and price, if different from standard price).

The invoice is displayed on screen, so that you can check and correct it as necessary. The program prints invoices on standard forms from NEBS (New England Business Service).

This procedure affects the following fields for each item on the invoice:

—ITEMS IN STOCK is decreased by the number sold.

—ITEMS SOLD PERIOD-TO-DATE and ITEMS SOLD YEAR-TO-DATE are increased by the number of items sold.

—SALES PERIOD-TO-DATE and SALES YEAR-TO-DATE are each in-

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creased by the total value of the purchase.

After the files have been updated, you will be asked whether or not you are interfacing with the *VERSARECEIVABLES* program. If so, the following information will be supplied automatically from your *VERSARECEIVABLES* files—if not, then you must enter it manually now. The items in question are:

1) Invoice number
2) Invoice date
3) Customer name
4) Customer address
5) Shipping address (if different from billing address)
6) Tax Rate
7) Discount
8) Shipping charge
9) Handling charge
10) Misc. charge

After getting a chance to review and correct all these values, you are directed to set up the forms in the printer and run a test of the forms alignment. Then your invoice is printed out.

Print Reports

These are the reports generated by *VERSAINVENTORY*:

MASTER INVENTORY LISTING
ITEMS BELOW REORDER POINT
INVENTORY VALUE REPORT
PERIOD-TO-DATE REPORT
YEAR-TO-DATE REPORT
INVENTORY PRICE LIST
PHYSICAL INVENTORY LIST

Each report can be printed in sorted order according to your previous use of the SORT FILE option.

MASTER INVENTORY LISTING This is a complete dump of all the information that is stored in the Master Inventory File. The first page has a heading that includes your company's name and address, the date and title of the report.

ITEMS BELOW REORDER LEVEL This report lists all items in the file which have falled below the preset reorder point. The report includes item I.D. #, description, vendor's item #, vendor I.D., quantity presently in stock, number on backorder, number on order, the date ordered, the expected date of receipt, the reorder level and two reorder quantities.

INVENTORY VALUE REPORT This report will provide an estimate of the value of your inventory. The information included is the item I.D., description, department, location, unit, weight, quantity in stock, number on backorder, number on order, latest cost, average cost, and the value of your inventory based on both latest cost and average cost. The values are determined by the quantity in stock times the latest cost and quantity in stock times average cost.

PERIOD-TO-DATE REPORT Before running the "Zero Period-to-Date" function you should print this report. The totals that are printed on this document are lost when a new peiod is prepared for. This report provides you with a summary of the profit margin and the margin percent earned on each item in the course of the period. The report includes the item I.D., quantity of items in stock, and the items sold. The number of items on backorder are included also, since these are considered to have been sold. Total sales for the period and latest cost are reported as well.

YEAR-TO-DATE REPORT Before running the "Zero Year-to-Date" function you should print this report. The totals that are printed on this this document are lost when a new year is prepared for. This report provides you with a summary of the profit margin and the margin percent earned on each item in the course of the year. Included in the report are the item I.D., description, quantity in stock at the beginning of the quarter, quantity in stock, items sold, quantity on backorder, total sales for the year and latest cost.

INVENTORY PRICE LIST The price list is an informative listing of every item's selling price and alternate price. In addition, the report provides you with the item identification code, description, vendor's item number, vendor I.D., department, location, unit, and weight. There is even room for any comments you may have.

PHYSICAL INVENTORY CHECKLIST

At some point, it will be necessary to perform a physical inventory check to determine how many of each item of stock you actually have. This report details the item I.D., description, department, location, units, and weight. It provides you with the calculated number of items, the number on backorder, and the number on order. A space is provided to write in the actual physical count and a comment for each item.

That pretty much describes the action of the program itself. In addition to helping you learn to operate the program, the *VERSAINVENTORY* manual provides appendix sections dealing with the initial disk backup and formatting procedures, and encourages users to keep well-labeled archival data diskettes for each year, month, or other period.

(See front cover & page 66)

LETTERS TO THE EDITOR

Questions about Word Processor

I have your Word Processor and enjoy it very much. I also have the "Cleanup" game, and my wife loves it.

I have some problems with the word processor. I don't know how to use two of the commands, and I don't even know what they are supposed to do. The commands are:

1. Justify: what does it do, and how do I use it?
2. Keyboard Reverse: what does this mean?

Thank you for your help. With your magazine and a little help, I should learn how to use my TRS-80 Model 1, Level 2, 32K with 2 disk drives.

Rev. Charles G. Lockie
The Continental United Methodist Church
North Main Street
Continental, Ohio 45831

The Justify command is used to format a document that you want to print with even margins on both the right and left side of the page. It fills spaces into lines that do not extend all the way to the right margin. You can see the results of this command by using the Print command on the screen.

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Keyboard Reverse is intended for Model 1 users who do not have the lower case modification installed, but who have lower case available on their printer. It relies on the fact that, on the unmodified Model 1, lower case letters are actually produced when you hold down the shift key even though they are displayed in upper case on the video display. If you type normally, holding down the shift key for capital letters, all letters intended to be upper case will be lower case, and all letters intended to be lower case will be upper case. Keyboard Reverse changes everything so that they come out right.

If you missed the instructions for the word processor, they are in the April 1979 and April 1980 issues.

Questions about the Model 3

I have several questions about my TRS-80 Model 3 with 32K and two disk drives:

1. What is the difference between the plastic and ceramic covered memory chips?
2. How can I cut down the interference between the Model 3 and my TV set?
3. I compared the memory test program supplied by H & E Computronics (on the free cassette) to the memory test program on TRSDOS 1.3 and came up with different checksums. The memory test on the cassette showed the checksums as A=BBC4, B=DA75 and C=407C. Radio Shack's memory test showed the checksums as A=9639, B=407C, and C=2EF8. Is there a problem with the way each memory test calculates the checksums?
4. How can I determine the starting and ending addresses of programs on disk such as disk Scripsit?
5. I used the "I" command option in the MON-4 program to read the disk track that contains Basic and all that happens is a re-boot.
6. I am looking for a good second operating system which is compatible with TRSDOS and does not require a password to copy files or programs.
7. As a long time user of Scripsit, is there any way to back up Scripsit after the second time?

Thank you for your time and help.

Michael J. Parot, Jr.
PSC Box 3345
APO SF 96264

There should be no functional difference between the plastic and ceramic memory chips, although there may be a difference in price.

There is really no way to cut down on the interference between the Model 3 and your TV set. At least the Model 3 is much better in this respect than many other computers.

The memory test program supplied by Computronics is for the Model 1, whereas that on the TRSDOS 1.3 diskette is for the Model 3. The checksums are different for both machines, and in fact they are also calculated differently since the Model 3's ROM is larger than the Model 1's. If your Model 3 passes Radio Shack's test, it is good.

Normally it is a simple matter to determine the starting and ending addresses of programs stored on disk, because they are stored in blocks that allow these addresses to be read directly. These blocks start with four bytes that represent an ID, length, and starting addresses. The ID byte 01 means that the following data is loaded to RAM, and the byte 02 signifies the entry point address. The problem with disk Scripsit is that it resides on a protected diskette, which can't be read in the normal fashion.

The reason you may have gotten a re-boot when you tried to read a disk with MON-4 is that there are different versions of the program for different disk operating systems. TRSDOS 1.1 and 1.2 have sectors numbered from 0 to 17, whereas TRSDOS 1.3 has them numbered from 1 to 18. Trying to read sector 0 or 18 from a disk that does not contain it can cause rebooting.

While there are many good second disk operating systems for the Model 3, unfortunately there are none that are completely compatible with TRSDOS. However, there are unprotected copies of SCRIPSIT floating around. Maybe you can find a sympathetic Radio Shack store manager who will give you another backup copy.

Another Problem Solved!

It seems that every time I send a letter asking for your help, it stimulates whatever mental processes I may still have. My last letter was one of desperation — how do I get 40 tracks on a 40-track disk drive?

Well, the answer turned out to be too simple! After studying Mr. Pennington's book *TRS-80 Disk and Other Mysteries* I found out all about "zapping" the GAT table and the lockout table. I still couldn't get 40 tracks to run, and this was the point at which I started sending out letters. A few more tries and I started to reason it out in a rational fashion. It soon became clear that my new 40-track drive was in fact a 35-track machine. I won't go into the details — enough to say that it was a special deal. We finally got it straightened out, and now I have a certifiable, honest-to-Pete 40-track drive — double-sided to boot, and everything is functioning as advertised.

I'm sorry to have bothered you with another of my problems, but if nothing else, I have found that by writing to you, something happened to stimulate my own thinking. I'm looking forward to a long period of correspondence. I'm sure you're not!

Jay Cox
15 Lake Drive East
Wayne, NJ 07470

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Print invoices and store all transactions on disk.

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mother board required for modules and relays

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PROGRAM PREVIEWS

A. A. Wicks

This Month: The Custom TRS-80 by Dennis Bathory Kitsz

If you had been awaiting the publication of "The Custom TRS-80 & Other Mysteries" with bated breath you would have expired long before now. But hold your breath no more. As of this writing (May), it has been available for a month or more, and suppliers have advised me that it is much in demand. This is not too surprising, as the build-up has been tense. This was not an advertising gimmick, either.

For those of you who may not be aware of the circumstances, this book has been advertised in most of the monthly computer magazines and elsewhere for nearly two years — first, as "available;" next, as "delayed," and now — well, it's really available. Although I am not familiar with the exact details, it is my understanding that it was a case of too much material and too little editorial and production time, with sales advertising too early.

Unfortunately, for the author and producers, some of the advertising dollars were undoubtedly wasted because of this. Then too, many of the potential buyers may no longer be interested — for this book is mainly about the TRS-80 Model I, and many previous owners of this computer have now discarded, upgraded, or switched.

The foregoing is not meant to detract from the quality of the book — which is excellent in scope, technical content, writing and thoroughness. It is written with the neophyte in mind, as well as for the accomplished technician. Although primarily hardware-oriented, there is considerable software material (mostly to work with the hardware), and a rather heavy portion of assembly language routines.

The book starts gently enough. You don't know which end of a soldering iron will burn you? No matter — the author takes you by the hand, tells you the tools and materials you will be using, what they are, how to use them. He then describes schematic drawings and their symbology, logic symbols, and, because many of the circuits to be described in the book might be called experimental, a power supply is recommended with instructions for its construction or purchase. All of this is passed over quickly, but nevertheless with detailed thoroughness.

From this point on, the author and reader are delving into the Model I, looking at it, probing inside the case, modifying its operation, and building internal and external accessories for it. Each chapter begins by briefly stating what will be accomplished, then provides some theory, before providing the details on accomplishing the plan for the Chapter. At times the text wanders, but in a relevant and interesting way, to associated subjects. One of the most informative techniques is the "boxing" of pertinent information frequently throughout the book. The information contained in these boxes could apply at anytime for reference, somewhat as an encyclopedia of handy hints. For instance, a half-page box including a line drawing is titled "Tips on Handling Integrated Circuits." Another, "Cleaning the Keyboard."

The subjects discussed Chapter by Chapter are far too many to describe or even list in detail in a review. Some are brief, and some are lengthy; all are valuable. A skimming of the Contents provides (to name only a few subjects) — Number Systems, What's in a Memory Map?, Important Hardware Areas, Wire-wrapping Techniques, Packing BASIC with Machine Code, Sound Effects Generation, Machine Language Monitor, Opening and Closing the Case, Up-Front Reset, Reversing Video, Upper-Lower Case, The Expansion Interface, Increasing Memory, Fixing the Stuck Relay, Hi-resolution Graphics, Controlling the World, Talking to the World (modems). An entire Chapter is devoted to media storage, with excellent information on disk drives, a description of just about every disk operating system that is available, the Exatron Stringy Floppy, cassette systems, and even paper tape readers and the conversion of an eight-track cassette system.

Hardware problems are then covered, with emphasis on repairing failed units; cables, memory crashes, video alignment and repairs; and care of peripherals. A Section known as "Cures for the Common Crash" could be valuable to anyone. In fact, although directed toward the TRS-80, this book has so many facets that it would be a good investment for anyone, no matter what personal computer they are using.

The book concludes with seven useful Appendixes. The first one, "Parts Suppliers," gives the author's viewpoints on the integrity of various firms, and thoroughly rejects one. A Bibliography in Appendix II provides a useful listing of texts and periodicals associated with electronics and data processing. Appendix III provides five pages of byte values and their equivalents, and all graphics characters. Another Appendix provides a good eight-page Glossary containing some subjects that probably appear in no other publication, at least not as an explained subject word. For example, "Direct Statement in File." Another, "Displacement," (as pertaining to disk file sectors). There are also some computer-slang expressions that may have particular significance to anyone wondering about their use in this environment. As an example, "Clobbered" is explained, as is "Zap" and "Flaky." Appendix VII lists by subject, all Parts Lists for each project in the text, and printed circuit board layouts. The latter, in some cases, may have doubtful value to the reader of this book — partly because some are too complex to be duplicated, subsequently they are unsatisfactory reproductions to be acceptable for circuit board preparation.

The overall production of this book is good. Double-column justified text has been used for the entire 335 pages, and the type font used for the body text and various headings is clear, nicely line-spaced and easy to read. Printing is by offset press, which means it is among the best

continued on page 32

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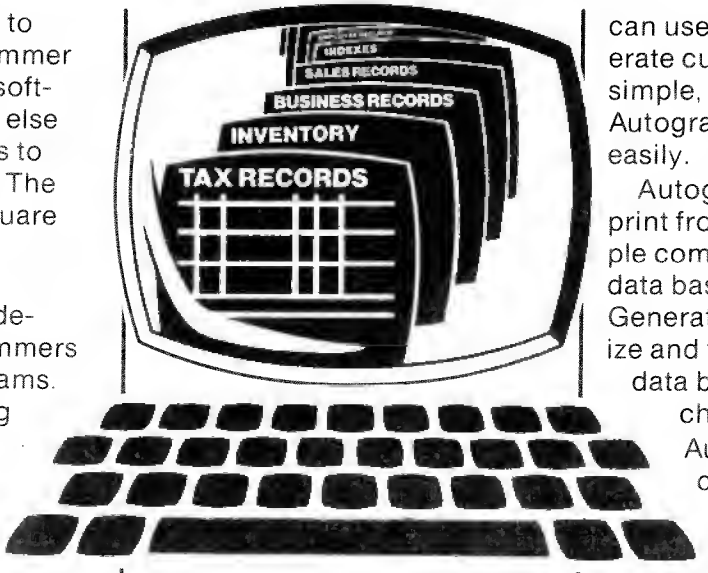

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FIRST OF A SERIES

ARRAY OF HOPE FOR BASIC PROGRAMMERS (PART 1)

Arne Rohde

1. Introduction

Arrays of one kind or another are used in a very large proportion of Basic programs, yet the variety of techniques used to manipulate these arrays is probably fairly limited. Often the array will only be accessed in serial or sequential form, although other access methods would often be more efficient, perhaps by an order of magnitude or more. It is the intention of this series of articles to explain some of the access and manipulation methods available in Basic, specifically on the TRS-80 Model I, Level II. However the techniques are applicable to most versions of Basic, and also to other programming languages.

2. Definitions

An "array" is a collection of data which are related to each other in a specific way, and each of which can be accessed individually at any time. A specific occurrence of this data is called an "element" or "node". An array element is addressed by its position relative to the beginning of the array, where each element counts as a single position. In Microsoft (TRS-80) Basic, an array may have any number of dimensions, with one positional reference being required for each dimension to define the address of a particular element. A positional reference is called a "subscript" or "index", with the first element in each dimension having relative position zero.

Special forms of arrays are often given unique names to identify the structure of the array. Arrays with two or more dimensions are often called "matrices", and arrays with two dimensions are also known as "tables" since two dimensional arrays can be printed in tabular form with rows and columns of values. The first subscript is usually referred to as the row number and the second dimension as the column number. A "stack" is a special form of a single dimension array, where only the last inserted element can be direcly accessed. New elements are always inserted at or removed from the "top" of the stack. Stacks are also known as last in-first out (or LIFO) buffers. A "queue", or first in-first out (FIFO) buffer, is an array where only the oldest element in the array can be accessed or removed. Elements are accessed at the beginning or head of a queue and inserted at the end or tail of a queue. A special format of the queue where the elements can be accessed at either end is known as the double-ended queue, or "deque" (pronounced as "deck").

A sequential one dimensional array is also known as a "linear list", to distinguish it from a list where each element contains one or more pointers to other elements in the list. This is usually known as a linked list. A special form of a linked list is known as a "tree". A tree has the properties that each element has 0, 1, or more subordinate elements, and each element is subordinate to no more than one other element. In a "binary tree" each element may have no more than 2 subordinate elements, and only one element may be subordinate to no other element. This element is known as the "root" of the tree. Elements with no subordinate elements are know as "leaves" or "leaf nodes". A linked list where the elements may be subordinate to more than one element is also known as a "network". Examples of most of these array types will be given later.

There are a number of operations which are commonly performed on arrays or linked lists (in future the term "array" will also cover linked lists, unless they are specifically excluded). In order to construct an array containing elements, it is necessary to be able to insert an element into the array. To read information from a specific element, an access mechanism will have to be provided. Sometimes it will also be necessary to remove or delete an element, to search for an element fulfilling a certain condition, or to order or sort the array into a specific sequence. Depending on which operation is required most frequently, the array can often be constructed in a way which optimizes that function. The array storage medium can also influence the construction, since arrays need not be resident in memory.

In Basic, an array element will normally only contain a single unit of information, such as a numeric value or a name. In many other languages it is possible to combine several items of information into a single element, which will then often be referred to as a "record". The equivalent can be achieved in Basic by using a two-dimensional array if the data items are of the same type, or related one-dimensional arrays if they are of different type.

3. Array Definition

An array in TRS-80 Basic is static, since the number of dimensions and the maximum number of elements in each dimension is fixed at the time when the array is defined, either explicitly with a DIM statement, or implicitly by referencing an element of the array. If an array is defined implicitly by reference, then the number of dimensions will be equal to the number of subscripts used, and the maximum number of elements in each dimension will be 11 (numbered from zero to ten). If the array is defined explicitly, then the number of elements in each dimension will be one larger than the value used as subscript, since subscript zero can also be used. To define a two dimensional array, A, with 2 data items in each row and with 25 rows, the statement DIM A(24,1) is used. The array will contain 50 data items altogether. A three dimensional array could be defined with DIM B(5,5,1). This array would contain 6*6*2 or 72 data items.

A subscript value must always evaluate to a non-negative integer. Real variables and expressions used as subscripts will be converted to an integer value with the CINT function — in other words they will be truncated and not rounded. The number of subscripts required to reference a

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particular array element must obviously be the same as the number of dimensions in the array. An element in the array A defined above could be referenced with A(I,J), where I is the row number and J the column number. To reference the array B, the expression B(I,J,K) could be used. Note that I, J or K could also be subscripted variables, with nesting allowed to any depth. The expression B(A(I,1), A(I+1,1), A(I+2,1)) would be legal, provided the values of the three subscripts did not exceed the values used to define the array B.

Arrays may be defined for all variable types: integer, single precision real, double precision real and string. The memory requirements for an array will depend on the type of variable, the number of dimensions, and the number of elements in each dimension. Arrays are stored in Basic following the simple variables (variables which do not require a subscript), and thus they must be moved in memory whenever a new simple variable is defined or referenced. This can take a noticeable amount of time if very large arrays are used, especially if several new simple variables are defined in succession. This can be avoided by referencing all simple variables before the arrays are defined.

4. Array Storage

The first byte of each array definition indicates the type of variable, with the value 2 for integer, 3 for string, 4 for single precision real, and 8 for double precision real. This corresponds to the number of bytes required for storing each element in the array area. The next two bytes contain the first two characters of the array name, but without any type qualifier, even if this was used in the array definition. The type is implicit from the first byte containing the element length. The name is stored with the second character first, and if the name only consists of one character then this byte will contain binary zero. To facilitate searching through the array storage area, the next two bytes contain the number of bytes required by the array, excluding the first 5 bytes of the array definition. With this value the address of the start of the following array definition can be calculated directly. One byte is used to store the number of dimensions in the array, and this value can be from 1 to 255. In other words, an array may have a maximum of 255 dimensions, which is more than can be referenced, since the number of characters which can be entered in a single line of Basic is about 250. Thus, with one character for each subscript and a comma as separator, no more than about 120 dimensions can ever be referenced. If each dimension in a 120 dimension array only contains 2 elements, then the total number of elements would still be 2 to the power of 120, which is a very large value. Storage availability would seem to set the limit at about 14 dimensions with two elements in each dimension. Very few applications probably need arrays with more than 3 dimensions, and this is the limit imposed in the programming language Cobol.

Each dimension requires two bytes for indicating the maximum number of elements in that dimension. These numbers immediately follow the byte with number of dimensions, and the value will be one larger than the number used for defining the array. They are stored with the last dimension first, so that an array defined with DIM A(1,2,3) would contain the values 4, 3 and 2 in the number of elements per dimension. This may perhaps seem unusual, as may the sequence in which the actual elements are stored. The data immediately follows the bytes containing the number of elements per dimension. The storage sequence for the array A(1,2,3) is A(0,0,0), A(1,0,0), A(0,1,0), A(1,1,0), A(0,2,0), ... A(0,2,3), A(1,2,3). In other words, the first dimension is varied first. The relative position of an element A(i,j,k) in this array can be calculated by the formula i + j*4 + k*3*4 or ((k*3) + j)*4 + i, where the 3 and 4 correspond to the number of elements in the second and third dimensions. This relative position must be multiplied by the length of each element to get the actual address within the array.

The array A(1,2,3), where A is an integer, would have the following representation in memory, with each byte shown as two hexadecimal digits. The element A(I,J,K) has been assigned the value I*12 + J*4 + K in order to provide the 24 elements with different values.

```
02 00 41 3700 03 0400 0300 0200 0000 0C00 0400 1000 0800
1400 0100 0D00 0500 1100 0900 1500 0200 0E00 0600 1200
0A00 1600 0300 0F00 0700 1300 0B00 1700
```

The value 02 indicates an integer array, with each element of length 2 bytes, and 0041 is the name "A" padded with zero. All two byte values are represented with the least significant byte first, as is the custom for values in a Z80 (as used in the TRS-80) or 8080 microprocessor. The value 3700 or 55 (decimal) is the length of the remaining part of the array, 03 is the number of dimensions in the array, and 0400, 0300 and 0200 are the number of elements in each of the three dimensions. All the following two byte values are the values of each array element in the sequence A(0,0,0), A(1,0,0), A(0,1,0), ... A(0,2,3), A(1,2,3). The value of each subscript can be calculated from the value of the element in this example.

The 3-byte length for string arrays may seem strange, but these 3 bytes consist of one byte for the length of the string (from 0 to 255) and 2 bytes pointing to the start address of the actual string. This will normally be in the string area reserved with the CLEAR n statement, unless the string value has been assigned directly as a literal or with a READ from a DATA statement. In these cases the string is embedded within the program text, and no space in the string storage area is required for the string. Arrays for numeric variables contain the actual values within the array, and not merely pointers to values in other parts of memory.

(To be continued)

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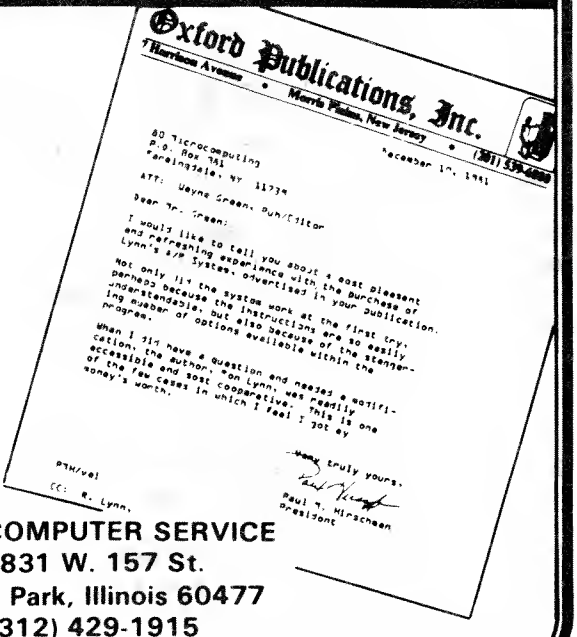
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PROGRAM CONVERSION (PART VIII)

Richard Kaplan

This month I will discuss techniques for BASIC language conversion to computers which do not use MICROSOFT BASIC. First, however, I will solve last month's "mystery" of Model III DISK BASIC error codes and the "new" (?) Model III ROM.

NO ERROR IN ERROR CODES?

For those readers who did not see my discussion of error codes last month, I questioned why Tandy altered the documented error codes in the Model III manual. The preliminary Model III manual (issued to those who purchased Model III's before the final manual was made available) listed a group of disk error codes beginning with # 100, such as "File not Found" (documented in the preliminary manual as error # 106). Tandy's more recent Model III manual, however, lists a different set of error codes for the same errors, beginning with # 51. This new set of error codes exactly corresponds to the correct set of Model I error codes.

As I mentioned last month, if one follows the Model III's original error codes, it is necessary to use the expression ERR/2+1 in order to obtain the correct error code for most errors; however, this does not function properly with the DISK BASIC errors. The preliminary (original) Model III manual documents a *Field Overflow*, for instance, as error number 100. However, 100 is the actual value generated by the expression ERR, so ERR/2+1 should not be used, if one follows a literal interpretation of this TRSDOS manual.

THE SOLUTION!!

Now for the solution to this mystery: There has *not* been any modification to the Model III ROM or to the Model III operating system affecting error codes, nor has there been an "error", per se, in either Model III manual. In that case, I must have erroneously stated certain error codes last month. Right? **Wrong!**

The error codes printed in the preliminary Model III manual (those published last month as the "correct" Model III error codes) reflect the actual value of ERR when that error occurs. The values printed in the present Model III manual, however, reflect the "adjusted", or "true", error codes. In other words, a Field Overflow has an error code of 100 in the original Model III manual. If such an error occurs and the statement PRINT ERR is executed, 100 will be the printed result. If, however, the command PRINT ERR/2+1 is used, then the value 51 would be printed, and this 51 is the value which is now found in the Model III TRSDOS manual.

The final application of these facts is to use ERR/2 + 1 in ALL situations on the Model III and to use the codes listed in the present Model III manual (which, in the case of the DISK BASIC codes, are the same as the Model I error codes—see last month's chart).

Tandy's switch to the lower error codes in their manual is a good idea, as these codes are the same as for the Model I. Of course, a programmer could have always used ERR/2 + 1 for DISK BASIC errors and the lower error codes, but if a program is written for a commercial purpose (to be mass-marketed), error codes displayed during the execution (or termination) of a program must coincide with those in the manual.

ON MICROSOFT BASIC

All three TRS-80's and most popular microcomputers use Microsoft BASIC. Microsoft is a firm whom many hardware manufacturers contract to design thir BASIC interpreters.

Although each version of BASIC that Microsoft designs is in some way different from all others, the essential elements of programming these computers remain consistent. The result is that Microsoft BASIC has become more or less a generic name for a particular type of BASIC programming.

ARE THERE ANY OTHER TYPES OF BASIC?

As I previously stated, Microsoft BASIC has become noted for its particular method of approaching BASIC programming. There are, however, other "dialects" of BASIC. HP (Hewlett Packard) BASIC is probably the most popular among the "non-Microsoft" BASICs. "HP"-type BASIC is used on several popular computers, including most HEWLETT PACKARD computers (of course!), the ATARI 400 and ATARI 800, and some NORTHSTAR computers.

RULE # 1: ARE THERE ANY "STRINGS" ATTACHED?

There are several distinct differences between Microsoft BASIC and non-Microsoft BASIC (usually known as HP BASIC, but used on ATARI and NORTHSTAR as well). The most formidable obstacle, however, when converting between Microsoft BASIC and HP BASIC is string handling.

Microsoft BASIC allows what is known as a "simple" string variable (as opposed to a "dimensioned" string variable, which is an element of an array) to have a capacity of up to 255 characters. No DIMension statement is required to use such a variable. DIMensioning is used to specify an array, which is a group of simple variables. String manipulation (concatenation, truncation, etc.) is generally performed with LEFT$, RIGHT$, and MID$.

As an example, if one wished to store his name in a string variable the command A$="RICH KAPLAN" would be sufficient in Microsoft BASIC. In order to store 5 names, the following sequence would be required:

```
DIM A$(5)
A$(1)="RICH":A$(2)="STEVE":A$(3)="HOWARD":A$(4)="BEA":
A$(5)="ANDY"
```

In this simple example, if one wished to later PRINT these names, the following routine would be executed:

```
FOR I= 1 TO 5
PRINT A$(I)
NEXT I
```

By examining the preceding two short routines, it is evident that Microsoft BASIC would treat each of the five names as a separate variable, any of which could be independently changed and/or made larger or smaller. This is *not* so with HP BASIC string arrays.

HP BASIC requires that *all* string variables be dimensioned before use. A DIMension statement specifies the maximum length of the particular string. Unlike Microsoft BASIC, in HP BASIC a string variable can be thousands of bytes long. Unfortunately, though, arrays are not supported in HP BASIC. As a result, a "constructed" string array must be used, which lends itself to a confusing program and slow execution time. In addition, LEFT$, RIGHT$, and MID$ do not exist in most implementations of HP BASIC. Instead, subscripts, such as A$(1,5), are used.

Recalling my example with Microsoft BASIC of storing a name in a string array, the command A$="RICH KAPLAN" would place my name in to variable A$. With HP BASIC, this variable would have to be dimensioned to a maximum length (note that the selection of 20 in the following example is purely arbitrary) and then assigned, as follows:

```
DIM A$(2Ø)
A$="RICH KAPLAN"
```

In order to place 5 names in an "array" in HP BASIC, a technique such as the following would be used:

```
DIM A$(5Ø)
A$(1,4)="RICH":A$(11,15)="STEVE":A$(21,26)="HOWARD"
A$(31,33)="BEA":A$(41,44)="ANDY"
```

In order to print these 5 names, a technique such as the following would be used:

```
FOR I = 1 TO 5
PRINT A$((I-1)*1Ø+1,I*1Ø)
NEXT I
```

I will elaborate upon and clarify further the previous technique later; my point is simply to stress the large difference in programming technique between HP and Microsoft string arrays.

A "PROPER" TECHNIQUE?

The question of the "proper" method of string handling is one which has been around for quite a while, and there will probably never be a resolution. Microsoft claims their technique is easier to use, and HP-type companies counter by claiming their technique is more logical and therefore more appropriate for advanced programming concepts.

Having been involved in the conversion of many programs to HP-type computers, I would unquestionably agree with Microsoft; nevertheless, the reality is that

continued on page 24

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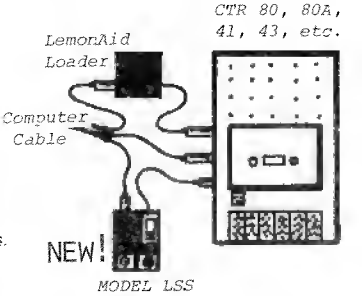

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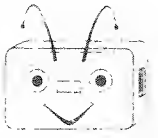

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PROGRAM CONVERSIONS

continued from page 21

sometimes programs *do* have to be converted, and therefore the need for conversion techniques, such as the "construction" of a string array, exists.

MICROSOFT STRING HANDLING

Microsoft string handling is fairly straightforward. All that is necessary is a DIM statement to specify the number of elements in an array (if larger than 10). After that, each element of an array may be treated as an independent variable. (See my previous example.)

In order to selectively assign or print a portion of a string variable (whether "simple" or "dimensioned"), LEFT$, RIGHT$, and MID$ are used in Microsoft BASIC. LEFT$ takes the form LEFT$(X$,X), where X$ is the string variable to be worked with and X is the number of characters, starting at the left, which one wants to use. In the following examples, we will assume that the command A$="ABCDEFGHIJKLMNOPQRSTUVWXYZ" has been executed.

```
> PRINT LEFT$(A$,5)
  ABCDE
>

> Z$=LEFT$(A$,3)
> PRINT Z$
  ABC
>
```

RIGHT$ functions exactly as LEFT$ does, except that it takes the rightmost characters. For example:

```
> PRINT RIGHT$(A$,3)
  XYZ
>
```

MID$ is used to select some portion of a string in the middle. For example:

```
> PRINT MID$(A$,3,6)
  CDEFGH
>
```

(The preceding example starts at the third character of A$ and extends 6 more characters.)

MID$ may also be used to alter a portion of a string array. For example:

```
> MID$(A$,1,1Ø)="123456789Ø"
> PRINT A$
  123456789ØKLMNOPQRSTUVWXYZ
>
```

Finally, string concatenation (combining strings) is performed in Microsoft BASIC just as numerical addition would be performed. For example:

```
> PRINT A$ + A$
  ABCDEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJKLMNOPQRSTUVWXYZ
```

HP STRING HANDLING

HP string handling is considerably more complex than is Microsoft string handling. I will discuss a simulated array in a later section of this article. Meanwhile, I will present some essential princples of HP-type string handling.

HP BASIC's syntactic construction mandates that *every* string variable be dimensioned to a maximum length. All HP string variables are simple variables (no arrays are permitted directly), but, unlike in Microsoft BASIC, the maximum size for a string is dictated only by available memory. (You may recall that Microsoft will only permit 255 characters in a single string variable).

LEFT$, RIGHT$, and MID$ do not exist in HP BASIC. In HP BASIC, the expression A$(X,Y) signifies all characters between the Xth and Yth characters, incluseve. As examples, the following are equivalent expressions for the Microsoft expressions demonstrated above:

```
HP EXPRESSION              MICROSOFT EQUIVALENT

> PRINT A$(1,5)
  ABCDE                    LEFT$(A$,5)
>

> PRINT A$(1,3)            LEFT$(A$,3)
  ABC
>

> PRINT A$(24,26)          RIGHT$(A$,3)
  XYZ
>

> PRINT A$(3,8)            MID$(A$,3,6)
  CDEFGH
>
```

Note that Microsoft requires a starting byte and a length, whereas HP requrires a starting and ending byte. See conversion chart below for further clarification.

```
> A$(1,1Ø)="123456789Ø"                MID$(A$,1,1Ø)
> PRINT A$
  123456789ØKLMNOPQRSTUVWXYZ
>
```

To summarize conversions for LEFT$, RIGHT$, and MID$, I have prepared the following table:

MICROSOFT EXPRESSION	HP EXPRESSION
LEFT$(A$,Y)	A$(1,Y)
RIGHT$(A$,Y)	A$(LEN(A$)-Y+1,LEN(A$))
MID$(A$,X,Y)	A$(X,X+Y-1)

HP BASIC does not have a concatenation operator (such as + for Microsoft). Instead, the second portion is added on at the byte one higher than the present length of the string. For example, as when we concatenated A$ to A$ in our Microsoft example:

```
> A$(LEN(A$)+1)=A$
> PRINT A$
  ABCDEFGHIJKLMNOPQRSTUVWXYZABCDEFGHIJKLMNOPQRSTUVWXYZ
```

In general, the Microsoft expression C$=A$+B$ becomes two statements under HP BASIC:

```
> C$=A$
> C$(LEN(C$)+1)=B$
```

THE "CONSTRUCTED" STRING ARRAY

As I have mendioned numerous times, string arrays, per se, do not exist in HP BASIC. A routine must be developed which will *simulate* a string array.

When simulating a string array in HP BASIC, it is first necessary to decide upon some maximum value for any one element in the array. Let's say, for example, that we wish to store in an inventory the names of 5 products, none of which exceeds 30 characters in length. If we wished to place these names into "array" A$, we would type DIM A$(150). The numeral 150 represents 5 items times 30 characters—the total number of characters to be stored in A$.

A$ will not really be an array, but rather a very long variable with the names of all 5 products in it. The first name will be kept in bytes 1 through 30, the next in bytes 31 through 60, etc., until the fifth name, which will be kept in bytes 131 through 150.

If you examine the preceding paragraph mathematically, you will see that we can mathematically define item I as being located in byte (I-1) * 30 + 1 through byte I * 30. In other words, item 2 is located in byte (2-1) * 30 +1 through byte 2 * 30, which simplifies to byte 31 through byte 60, as stated in the preceding paragraph.

In order to load our 5-element array with the names of our 5 inventory products, we could use the following short program:

```
10 DIM A$(150)
20 FOR I = 1 TO 5
30 READ X$
40 A$((I-1)*30+1,I*30)=X$
50 NEXT
60 DATA VERSALEDGER,VERSAPAYROLL,
   VERSARECEIVABLES,VERSAPAYABLES,
   VERSAINVENTORY
```

In order to later print out these names, we could use the following program:

```
10 FOR I = 1 TO 5
20 PRINT A$((I-1)*30+1,I*30)
30 NEXT I
```

Note that this program is essentially identical to the program listed under "RULE # 1 — ARE THERE ANY 'STRINGS' ATTACHED?", except that in line 20 I substituted 30 for 10 since I desired 30 characters for each of our inventory items.

To summarize a constructed array in general terms, we can say that for array A$ of X elements and a maximum of Y

continued on page 31

PRACTICAL BUSINESS PROGRAMS

A PROGRAM FOR THE SIMPLEX METHOD OF LINEAR PROGRAMMING

Steven M. Zimmerman, Ph.D. and Leo M. Conrad

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The simplex method of linear programming is the most flexible of all the linear programming techniques. The biggest limitation on the simplex method is that some problems that can be solved with other techniques tend to become very large when formatted as a simplex problem.

A typical simplex problem is designed to identify the decisions that will minimize a cost function or maximize a profit function subject to a set of restrictions on the decision to be made. The mathematical formulation may get a little technical for some applications. One nice thing about working with all linear programming applications is that all cost or functions, profit functions, and restrictions are straight line relationships.

We will give a brief review of the theory and background of the simplex linear programming concept. We will detail the use of our program to solve this type problem. The program is not difficult to use, but great care must be taken in setting up the problem of interest and in understanding and using the results of the program.

Theory and Background of the Simplex Method — A profit Example

A sample of a profit Objective function is:

$$f(x(i)) = 23\ X(1) + 44\ X(2) + 12\ X(3)$$
$$i = 1, 2, 3$$

The left hand side says this is a function of X(i). The right hand side says the profit of X(1) is 23 per something per unit, the profit of X(2) is 44 per unit, and the profit for X(3) is 12 per unit.

X(1), X(2), and X(3) are any three decision variables of interest. X(1) may be the number of sales persons to locate in store one, X(2) could be the number of sales persons to locate in store two, and X(3) could be the number in store three. Or alternatively X(i) may be the amount of a given product to maintain in stock. The only restriction on what the X(i)'s can stand for is that they should be things which the manager, business person has control of. If the manager is not free within limits to control the decisions under consideration, in actual fact he has no decisions to make.

The number in front of each X(i) must be the profit per unit for the profit objective function or the cost per unit for a cost function. The units may be things or people or whatever the decision being studied is.

All decisions have some limits on them. For example some potential limits in a maximization problem such as the one under consideration could be as follows:

$4\ X(1) + 6\ X(2) + 7\ X(3) >= 50$

$X(1) + X(2) + X(3) >= 100$

and $X(i) >= 0$ or $i = 1, 2,$ and 3

The first restriction could be from the budget available to do the job. If the cost of each item is shown in front of the item we might be limited by the sum of these costs being less than $50. or $50,000 etc.

An example of a constraint due to the amount of storage space available could look like the second equation above. This equation says the total number of items available must be less than or equal to 100 units.

The last constraint is very common in business problems. Many business decisions are such that the value of the decision variables must be greater or equal to zero. The solution procedure we have select have this constraint build in. If you are looking at engineering or chemical type problems which do not have this constraint then our program may not be a good selection for you.

You will notice all our constraints (with the exception of the non-negativity constraint) are of the form where the calculated value is less than or equal to some number. For maximization problems you must present the constraint to the computer in this form. For minimization problems you must present the constraints to the computer in the form where the sum of the values must be greater or equal to some value.

We analyzed this example with our program and obtained the following results:

X(1)= 0
X(2)=8.33
X(3)=0
Value of Objective function 366.67

You will notice the program instructs the user to sell product two only. The maximum profit of $366.67 can only be obtained following this plan. All the constraints are satisfaied with this decision. The only thing which may or may not make sense is 8.33 items are assigned to X(2) rather than 8 or 9. The program is not an integer programming technique.

A Cost example

A cost function is defined in an manner similar to the profit function:

Cost Objective function:

$$f(x(i)) = 33\ X(1) + 62\ X(2)$$
$$i = 1, 2$$

Although the two equations look similar, their meanings are not. In the cost case the coefficients in front of the X's are the cost per unit rather than the profit per unit. The decisions of interest in this case could be the number of people to hired. Two types are identified with different costs and performance abilities.

The constraints on a cost objective function all are greater or equal to constraints such as the following:

$14\ X(1) + 24\ X(2) >= 666$

$X(1) + X(2) >= 80$

$X(1) >= 25$ and

$X(i) >= 0$ for $i = 1, 2,$ and 3

If the 14 in front of the X(1) and the 24 in front of the X(2) are productivity measures, constraint number one above could be saying the number of items produced per unit time must be greater or equal to 666 units.

The second constraint could be specifying the total number of individuals must be greater or equal to 80 and the next constraints says 25 of these people must be X(1)'s.

The last constraint is the same non-negativity constraint which we have already reviewed relative to the maximization problem.

Theory — Maximum or Minimum

The number of variables (X(i)) and the number of constraints are limited by the print out format of the screen or printer and the amount of time you are willing to let the computer operate. We selected minimization and maximization problems with different numbers of variables and constraints to illustrate the flexiability possible.

It is possible to create a problem where no solution exists which can satisfy the limitations defined. Be sure to check the set up of your problems with care and to spend some extra time reviewing the results obtained to make sure they do in fact make sense for the application under consideration.

We ran this set of equations through our program and obtained the following results:

X(1)=80
X(2)=0
Value of the objective function 2640.00

After checking to see if all the constraints were satisifed we see the only way to minimize our costs is to use 80 of X(1)'s and non of X(2)'s in our business. If this is not acceptable in real life it does not mean the program did not do its job but rather it means the constraints used in the example do not reflect the actual business situation. If this is true there is something wrong with the set up of the problem and it must be reexamined. We have more than once analyzed a problem and then found it necessary to redefine the problem after examining the results produced by the computer.

RUNNING THE PROGRAM

The program starts out with the following explanatory material and question:

```
SIMPLEX SOLUTIONS
TO LINEAR PROGRAMMING PROBLEMS
FOR MAXIMIZATION ALL CONSTRAINTS ASSUMED TO
BE A*X(1) + B*A(2) ... >= C(J)
FOR MINIMIZATION ALL CONSTRAINTS ASSUMED TO
BE A*X(1) + B*A(2) ... <= C(J)
THE NON-NEGATIVITY CONSTRAINTS FOR ALL
VARIABLES ASSUMED
NUMBER OF VARIABLES?
```

The limitations relative to the nature of the constraints for the different type of problems and the non-negativity of the variables have already been reviewed. We will document

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both the profit and cost examples reviewed above. To save space the questions and answers only will be shown with no explaination until the example is complete.

Profit example

```
NUMBER OF VARIABLES? 3
NUMBER OF CONSTRAINTS? 2
 (1) MAXIMIZATION OR (2) MINIMIZATION? 1
INPUT OBJECTIVE FUNCTION'S COEFFICIENTS A*X(1) +
B*X(2) ...
? 23
? 44
? 12
INPUT CONSTRAINTS INCLUDING 0'S
A*X(1) + B*X(2) ... <>=Z
INPUT CONSTRAINT NUMBER   1
? 4
? 6
? 7
? 50
INPUT CONSTRAINT NUMBER   2
? 1
? 1
? 1
? 100
HARD COPY OR CRT (H/C)? C
```

If you elect to use your printer you will asked to input the name of the run and a date. If not, the computer will go directly into its analysis run.

Your screen has 64 characters or columns of output. Your printer may have more or less than this number. The device with the larger number of columns will handle the most variables.

The computer will walk through its solution procedure one tableau (the output table, matrix, is called a simplex tableau) at a time. If you are using printer output, it will continue to run until all of the material is printed. If you are using the CRT, screen, output you will be asked to hit the ENTER key so as to allow you to page through the solution as it develops.

The solution generated for this problem follows:

```
INPUT MATRIX
        X1      X2      X3      S1      S2
S1      4.ØØ    6.ØØ    7.ØØ    1.ØØ    Ø.ØØ    5Ø.ØØ
S2      1.ØØ    1.ØØ    1.ØØ    Ø.ØØ    1.ØØ    1ØØ.ØØ
      -23.ØØ  -44.ØØ  -12.ØØ    Ø.ØØ    Ø.ØØ     Ø.ØØ
PIVOTAL COLUMN  1       PIVOTAL ROW     1
        X1      X2      X3      S1      S2
X1      1.ØØ    1.5Ø    1.75    Ø.25    Ø.ØØ    12.5Ø
S2      Ø.ØØ   -Ø.5Ø   -Ø.75   -Ø.25    1.ØØ    87.5Ø
        Ø.ØØ   -9.5Ø   28.25    5.75    Ø.ØØ   287.5Ø
PIVOTAL COLUMN  2       PIVOTAL ROW     1
        X1      X2      X3      S1      S2
X1      Ø.67    1.ØØ    1.17    Ø.17    Ø.ØØ     8.33
S2      Ø.33    Ø.ØØ   -Ø.17   -Ø.17    1.ØØ    91.67
        6.33    Ø.ØØ   39.33    7.33    Ø.ØØ   366.67
```

```
SOLUTION OPTIMAL
        X1      X2      X3      S1      S2
X1      Ø.67    1.ØØ    1.17    Ø.17    Ø.ØØ     8.33
S2      Ø.33    Ø.ØØ   -Ø.17   -Ø.17    1.ØØ    91.67
        6.33    Ø.ØØ   39.33    7.33    Ø.ØØ   366.67
```

The program automatically set up the tables for the purpose of solving the problem. It added some variables called S1 and S2. These variables are called slack variables. They were added to change the inequalities we inputted into the program into equalities.

The manner in which the table is set up and the location of the answers. is a function of the type of problems being solved. In the case of maximizing a profit the answers are found by looking for Xi in the first column. In this case there is a X1 and a S1 in this column. Since neither X2 nor X3 appear here this means they are zero. The value of X1 is found by looking accross its row for the last number which is 8.33. This is the value of X1 in the solution.

The value of the objective function is always found in the same place, the last row, last column position. In this position you will see the number 366.67. This is the value of the objective function. Check this by inputting X1=0, X2=8.33, and X3=0 in the original objective function.

The pivotal column and row information simple tells us which column row combination was selected to seek a better solution in the next table.

Cost example

```
NUMBER OF VARIABLES? 2
NUMBER OF CONSTRAINTS? 3
 (1) MAXIMIZATION OR (2) MINIMIZATION? 2
INPUT OBJECTIVE FUNCTION'S COEFFICIENTS A*X(1) +
B*X(2) ...
? 33
? 62
INPUT CONSTRAINTS INCLUDING 0'S
A*X(1) + B*X(2) ... <>=Z
INPUT CONSTRAINT NUMBER   1
? 14
? 24
? 666
INPUT CONSTRAINT NUMBER   2
? 1
? 1
? 80
INPUT CONSTRAINT NUMBER   3
? 1
? 0
? 25
HARD COPY OR CRT (H/C)? C
```

The solution generated for this problem follows:

```
INPUT MATRIX
        S1      S2      S3      X1      X2
X1     14.ØØ    1.ØØ    1.ØØ    1.ØØ    Ø.ØØ    33.ØØ
X2     24.ØØ    1.ØØ    Ø.ØØ    Ø.ØØ    1.ØØ    62.ØØ
     %-666.ØØ  -8Ø.ØØ  -25.ØØ    Ø.ØØ    Ø.ØØ     Ø.ØØ
```

```
PIVOTAL COLUMN  1        PIVOTAL ROW    1
          S1       S2       S3       X1       X2
S1      1.ØØ     Ø.Ø7     Ø.Ø7     Ø.Ø7     Ø.ØØ      2.36
X2      Ø.ØØ    -Ø.71    -1.71    -1.71     1.ØØ      5.43
        Ø.ØØ   -32.43    22.57    47.57     Ø.ØØ     %1569.86
PIVOTAL COLUMN  2        PIVOTAL ROW    1
          S1       S2       S3       X1       X2
S2     14.ØØ     1.ØØ     1.ØØ     1.ØØ     Ø.ØØ     33.ØØ
X2     1Ø.ØØ     Ø.ØØ    -1.ØØ    -1.ØØ     1.ØØ     29.ØØ
      454.ØØ     Ø.ØØ    55.ØØ    8Ø.ØØ     Ø.ØØ    %264Ø.ØØ
SOLUTION OPTIMAL
          S1       S2       S3       X1       X2
S2     14.ØØ     1.ØØ     1.ØØ     1.ØØ     Ø.ØØ     33.ØØ
X2     1Ø.ØØ     Ø.ØØ    -1.ØØ    -1.ØØ     1.ØØ     29.ØØ
      454.ØØ     Ø.ØØ    55.ØØ    8Ø.ØØ     Ø.ØØ    %264Ø.ØØ
```

As noted in the profit case the solution is found in the last row and last column. In this case %2640.00 is found in this position. The % sign in front of the number simply means the value was too big to fit into the space formatted in the PRINT USING instruction of our program. Becasuse of the limited space on both our printer and CRT, we have found it acceptable to allow this overflow to happen. If you examine the input table you will see the same thing happened relative to the -666.00 found in the first column of numbers.

The answers in this case are found in last row of the X1 and X2 columns. In the X1 row is 80 and in the X2 row is 0. This means X1=80 and X2=0 in the optimal solution.

EXAMINING THE PROGRAM

Line numbers 10 through 440 are used to input the data for the problem to be solved. Line 100 is used to dimension the arrays to be used to contain the input data. The number of variables is inputted in line 70, the number of constraints is inputted in line 80. The objective function's coefficients are inputted in line 140 through line 290. The constraints are inputted from line 300 to 560.

The hard copy question is answered in lines 570-590 and the analysis starts in line 600 on. We have included a number of REMarks throughout the analysis to indicate what is being done at different points in the program.

PROGRAM LISTING

```
1Ø REM  "SIMPLEX"
2Ø CLEAR 5ØØ: CLS
3Ø PRINT "SIMPLEX SOLUTIONS TO LINEAR PROGRAMMING PROBLEMS"
4Ø PRINT "FOR MAXIMIZATION ALL CONSTRAINTS ASSUMED TO BE
A*X(1) +B*X(2) ... <=C(J)"
5Ø PRINT "FOR MINIMIZATION ALL CONSTRAINTS ASSUMED TO BE
A*X(1) + B*X(2) ... >= C(J)"
6Ø PRINT "THE NON-NEGATIVITY CONSTRAINTS FOR ALL VARIABLES
ASSUMED"
7Ø INPUT "NUMBER OF VARIABLES";V%
8Ø INPUT "NUMBER OF CONSTRAINTS";C%
9Ø INPUT " (1) MAXIMIZATION OR (2) MINIMIZATION ";M%:IF M% <
1 OR M% > 2 THEN 9Ø
1ØØ DIM X1(V%+C%+1):IF M%=1 THEN DIM X(C%+1,V%+C%+1) ELSE
DIM X(V%+1,V%+C%+1)
11Ø R%=C%+1
```


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```
120 CC%=V%+C%+1
130 IF M%=2 THEN R%=V%+1
140 PRINT "INPUT THE OBJECTIVE FUNCTION'S COEFFICIENTS
A*X(1)+B*X(2)..."
150 FOR I=1TOV%
160 INPUT X1(I)
170 NEXT
180 IF M%=2 THEN 260
190 FOR J=1TOV%
200 X(C%+1,J)=-X1(J)
210 NEXT
220 FOR J=V%+1 TO V%+C%+1
230 X(C%+1,J)=0
240 NEXT
250 GOTO 300
260 FOR I=1TOV%
270 X(I,V%+C%+1)=X1(I)
280 NEXT I
290 X(V%+1,V%+C%+1)=0
300 PRINT "INPUT CONSTRAINTS INCLUDING 0'S "
310 PRINT "A*X(1)+B*X(2)...<>=Z"
320 FOR I=1 TO C%
330 PRINT "INPUT CONSTRAINT NUMBER ";I
340 FOR J=1TOV%+1
350 INPUT X1(J)
360 IF M%=1 THEN 420
370 FOR K=1 TO V%
380 X(K,I)=X1(K)
390 NEXT K
400 X(V%+1,I)=-X1(V%+1)
410 GOTO 460
420 FOR K=1 TO V%
430 X(I,K)=X1(K)
440 NEXT K
450 X(I,CC%)=X1(V%+1)
460 NEXT J,I
470 FOR I=1 TO R%-1
480 IF M%=2 THEN 530
490 FOR K=V%+1 TO CC%-1
500 IF I=K-V% THEN LET X(I,K)=1
510 NEXT K
520 GOTO 560
530 FOR K=C%+1 TO CC%-1
540 IF I=K-C% THEN LET X(I,K)=1
550 NEXT K
560 NEXT I
570 INPUT "HARD COPY OR CRT (H/C)";P$
580 PRINT "INPUT MATRIX"
590 IF P$="H" THEN INPUT "TITLE & DATE";T$,D$: LPRINT T$,D$:
LPRINT "INPUT MATRIX"
600 DIM CL$(CC%),RL$(R%):REM LABELS
610 IF M%=1 THEN 720
620 FOR J=I TO C%
630 CL$(J)="S"+CHR$(J+48)
640 NEXT J
650 FOR J=C%+1 TO C%+V%+1
660 CL$(J)="X"+CHR$(J-C%+48)
670 NEXT
680 FOR I=1 TO R%-1
690 RL$(I)="X"+CHR$(I+48)
700 NEXT
710 GOSUB 820  :GOTO 990
720 FOR J=1 TO V%
730 CL$(J)="X"+CHR$(J+48)
740 NEXT
750 FOR J=V%+1 TO CC%-1
760 CL$(J)="S"+CHR$(J-V%+48)
770 NEXT J
780 FOR I=1 TO R%-1
790 RL$(I)="S"+CHR$(I+48)
800 NEXT I
810 GOSUB 820  :GOTO 990
820 CL$(0)="  ":RL$(R%)="  "
830 ZP$=" ###.## "
840 AP$=" %    % "
850 FOR J=0 TO CC%-1
860 PRINT USING AP$;CL$(J);: IF P$="H" THEN LPRINT USING
AP$;CL$(J);
870 NEXT : PRINT : IF P$="H" THEN LPRINT" "
880 FOR I=1 TO R%:REM PRINT RESULTS SUBROUTINE
890 FOR J=1 TO CC%
900 IF J=1 THEN PRINT USING AP$;RL$(I);: IF P$="H" THEN
LPRINT USING AP$;RL$(I);
910 PRINT USING ZP$;X(I,J);
920 IF P$="H" THEN LPRINT USING ZP$; X(I,J);
930 NEXT J
940 PRINT
950 IF P$="H" THEN LPRINT" "
960 NEXT I
970 IF P$="C" THEN INPUT "ENTER TO PAGE";DU$
980 RETURN
990 REM START OF ANALYSIS
1000 REM   NEGATIVE INDICATOR?
1010 N=0
1020 FOR J=1 TO CC%-1
1030 IF X(R%,J)<0 THEN LET N=1:JJ=J: PRINT "PIVOTAL COLUMN
";JJ: GOTO 1070 :REM JJ IS PIVOTAL COLUMN
1040 NEXT J
1050 PRINT "SOLUTION OPTIMAL": IF P$="H" THEN LPRINT
"SOLUTION OPTIMAL"
1060 GOSUB 820  :END
1070 M=9999999:REM SELECTING ROW
1080 FOR I=1 TO R%-1
1090 IF X(I,JJ)=0 THEN X1(I)=999999999: GOTO 1110
1100 X1(I)=X(I,CC%)/X(I,JJ)
1110 IF X(I,JJ)<=0 THEN 1130
1120 IF X1(I)<M THEN M=X1(I):II=I: PRINT "PIVOTAL ROW ";II:
REM PIVOTAL ROW
1130 NEXT I
1140 IF P$="H" THEN LPRINT "PIVOTAL COLUMN ";JJ,"PIVOTAL ROW
";II
1150 PV=X(II,JJ)
1160 FOR J=1 TO CC%:REM DIVIDE ITH ROW OLD BY PIVOT
1170 X(II,J)=X(II,J)/PV
1180 NEXT
1190 RL$(II)=CL$(JJ):REM RELABEL ROW
1200 FOR I=1 TO R%
1210 IF I=II THEN NEXT I: GOTO 1260
1220 A=X(I,JJ)
1230 FOR J=1 TO CC%
1240 X(I,J)=X(I,J)-A*X(II,J)
1250 NEXT J,I
```

```
126Ø GOSUB 82Ø
127Ø GOTO 99Ø
```

SUMMARY

The flexibility of the simplex method has been shown. The limitation on the simplex method relative to size can be seen by the small size of problem we handled in our examples.

Typical maximization and minimization simplex problems were reviewed in detail. The technical nature of the formulation of the simplex problem can be seen from our examples. The fact that all of the relationships used were linear can readily be seen.

The program is not difficult to use, but great care must be taken in setting up the problem, in understanding, and using the results of the program.

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P.O. Box 9843
Mobile, Alabama 36691-0843 ■

PROGRAM CONVERSIONS

continued from page 25

characters per element, the following statements should be executed:

```
DIMENSIONING: DIM A$(X*Y)
ASSIGNMENT  : A$(I) = ... becomes A$((I-1)*Y+1,I*Y) = ...
```

THE "CONSTRUCTED" DOUBLE-SUBSCRIPTED STRING ARRAY

Very often it is desired to use an array with more than one dimension. For example, we might wish to store the names of 3 students' classes in each of 3 periods. A$(1,1) would be student 1, class 1. A$(1,2) would be student 1, class 2. A$(3,2) would be student 3, class 2, etc. In total, there would be 3 times 3, or 9, elements of the array. In Microsoft BASIC, we would use the DIMensioning statement DIM A$(3,3), and a program could be written like this:

```
1Ø DIM A$(3,3)
2Ø FOR I = 1 TO 3
3Ø FOR J = 1 TO 3
4Ø READ X$
5Ø A$(I,J)=X$
6Ø NEXT:NEXT
7Ø DATA CHEMISTRY,ALGEBRA,ENGLISH
8Ø DATA ALGEBRA, BIOLOGY, FRENCH
9Ø DATA SPANISH, BIOLOGY, ENGLISH
```

In HP BASIC, just as there are no single-subscripted arrays, there are no double-subscripted arrays. The technique to construct a double-subscripted array, though, is quite

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similar to the technique described for single-subscripted arrays.

We can think of array A$(3,3) as being a set of 9 different variables. A$(1,1) is the first variable, A$(1,2) is the second, A$(2,1) is the fourth, etc. Just as our constructed single-element array described previously was merely a collection of contiguous simple variables, our double-subscripted array may be thought of as a collection of contiguous single-subscripted arrays.

By analyzing the second sentence of the preceding paragraph, it is possible to define mathematically that element A$(X,Y) is equivalent to element A$((X-1)*3+Y) of a single-subscripted array. Once we have a single-subscripted array, we can apply the previous formula and convert the single-subscripted array to a collection of simple variables. (Note: The 3 in the above example represents the number of elements alloted in the second portion of the DIM statement. If we had DIMensioned A$ as (4,5), we would have multiplied by 5 above.)

To clarify the preceding paragraph, element A$(1,1) may be thought of as element (1-1)*3+1, or the first element. Element A$(2,1) may be thought of as element (2-1)*3+1, or the fourth element.

To apply this technique, we can use the following program to again place 3 classes each for 3 students into an array. We will assume that no class name consumes more than 20 bytes.

```
10 DIM A$(180)
20 FOR I = 1 TO 3
30 FOR J = 1 TO 3
40 READ X$
50 Z=(I-1)*3+J: REM CONVERT A$(I,J) TO SINGLE ELEMENT
60 A$((Z-1)*20+1,I*20)=X$: REM 20 CHARACTERS MAX LENGTH
70 NEXT:NEXT
80 DATA CHEMISTRY,ALGEBRA,ENGLISH
90 DATA ALGEBRA,BIOLOGY,FRENCH
100 DATA SPANISH,BIOLOGY,ENGLISH
```

To print out all 9 elements we could use the following program:

```
10 FOR I = 1 TO 3
20 FOR J = 1 TO 3
30 GOSUB 100
40 PRINT A$((Z-1)*20+1,Z*20)
50 NEXT:NEXT
100 Z=(I-1)*3+J
110 RETURN
```

To summarize the technique for simulating a double-subsripted array on a computer with HP BASIC, assume we wish to simulate array A$ with X * Y elements of a maximum of L character each:

```
DIMENSIONING: DIM A$(X*Y*L)
ASSIGNMENT  : A$(I,J) = ... becomes two statements:
                Z=(I-1)*Y+J
                M$(Z-1)*L+1,Z*L) = ...
```

CONCLUSION

This concludes this month's discussion of program conversion. As always, reader input is welcomed. If you have any comments, suggestions, topics you would like covered, etc., or if you have a specific program which you are encountering difficulty translating, or if you have successfully converted a program using these techniques, please write and let me know.

Richard Kaplan
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50 N. Pascack Road
Spring Valley, NY 10977 ■

PROGRAM PREVIEWS
continued from page 14

of the various reproduction processes. The photographs are, in nearly every case, unsatisfactory — and this is unfortunate in an otherwise first-class book. This photographic or reproduction deficiency is particularly noticeable in the very areas where you would really like to have the best clarity — such as when a referenced item is described as being in the photograph — but you can't discern it. I would not hazard a guess as to the reason for the problem — usually the photographer blames the printer, and vice versa.

Some reflection of the haste with which the book was edited and produced is still evident. Several references to other Sections of the manual have remained as the author probably wrote them — "See Chapter (?)," for example. Also the headings for Appendixes IV, V, VII are entirely omitted. However, on the plus side, the Index for this book is one of the best that I have ever seen. It lists hundreds of subjects, with every occurence stated. In addition, the subjects are identified as being Discussed, a Program Listing, or Schematic Diagram.

Mr. Kitsz has completed a formidable writing task, and the Editor, David Moore, and the Publishers have produced a very fine publication. The author writes fluidly and lucidly. This is reflected in an ease of understanding that any reader will enjoy. Some of the subject material has appeared in computer magazines, but nearly all of it is new for this publication. All of the material will not be of value to all persons, but some of it is going to be invaluable to many. One simple but long-postponed electronics change that I made to my Model I, as a result of getting the information I needed from this book, was worth the price alone.

If you have any interest whatsoever in the "innards" of your Model I, this book will be useful to you. And even if you only wish to become "hardware-aware," the book will be helpful.

"The Custom TRS-80 & Other Mysteries" — Dennis Bathory Kitsz. Published by IJG Inc., Upland, Calif. Available from H & E Computronics, Inc. and other dealers — $29.95

HARDWARE REVIEWS

Joseph Rosenman

The EPSON Graftrax

It seems like yesterday, but it is now well over a year since I first wrote the EPSON MX-80 review. Since that time, I have had many trouble-free hours of printing. I've been through many ribbons, but I'm still using the original print head supplied with the printer. So (in a fit of printer boredom and insatiable curiosity) I bought the Graftrax modification for the MX-80.

What is Graftrax? It is a "Firmware" modification. Firmware is something "in between" hardware and software. What you get with the Graftrax package is an instruction manual and three ROM chips. What you need to do to install Graftrax is open the printer, replace the single ROM chip with the new set of three, and cut a jumper wire. Not too bad. The instruction manual is reasonably helpful in so far as the installation is concerned (not so when it comes to using the Graftrax, however).

What is Graftrax good for? There are three special operations that Graftrax permits:

(1) Italics printing,
(2) Enhanced special functions,
(3) Bit addressed graphics.

Yes, it can even slash its zeros. Does it work? Yes indeed. What do you lose? Not too much. If you were partial to printing Katakana (the Japanese characters), you might be unhappy. The dip switches have been re-mapped (they now mean different things). This change, of course, takes some getting used to. But, all things considered, you end up with a much more powerful printer.

Let me emphasize the most important point of all: the EPSON MX-80 with the Graftrax option becomes a very powerful graphic printer. It remains slow, since the printing speed is primarily hardware-dependent. It also is not simple to use. While it is true that you can now control the location of every dot on the page (and even overlap them!), such flexibility requires sophisticated software to "unlock" the power of Graftrax. I expect that some very interesting "Graftrax printer drivers" will soon appear. In the meantime, I will attempt to "explain" the way that you can use Graftrax today using BASIC or machine language.

The Graftrax manual provides a list of the various options in "numerical order". Each option exists as an "Escape-value" sequence. Some of the sequences are followed by a second value, which might be a count or argument. I will re-classify the different commands into logical groups, and provide an enhanced description of the use of the command.

Vertical Printer Commands

ESC 0	This command sets line spacing to 8 lines per inch. In this mode, there is virtually no space between successive lines (they sit one on top of the other).
ESC 1	This command sets line spacing to 7/72 of an inch per line. 1/72 is the size of one dot.
ESC 2	This command sets line spacing to 6 lines per inch. This is the "standard" setting.
ESC 3 n	This command sets line spacing to "n"/216 of an inch. 1/216 equals 1/3 of a dot. "n" must be within the range of 1 to 254 (where 254 = 84 2/3 dots)
ESC A n	This command sets line spacing to "n"/72 of an inch per line. 1/72 is the size of one dot. "n" must be within the range of 1 to 85.
ESC B n1 n2 ...	This command sets vertical tabs (after clearing any previous vertical tabs). There is a maximum of 16 vertical tabs permitted. Each "n" must be within the range of 1 to 254. (I believe each number refers to line number, starting from the "top-of-form".)
ESC C n	This command sets the form length to "n" lines, where n is within the range of 1 to 255.
0AH	This is the line feed character. It advances the paper by 1 "line", and prints whatever is in the print buffer.
0BH	This is the vertical tab character. It advances the paper to the next vertical tab stop.
0CH	This is the form feed character. It advances the paper to the "top-of-form".

Horizontal Printer Commands

ESC <	This command causes the print head to move to the left side of the printer.
ESC D n1 n2 ...	This command sets horizontal tabs (after clearing any previous horizontal tabs). There is a maximum of 16 tabs permitted. The tabs are set up so that: TAB 0 is column 1, TAB 1 is column 2, TAB 2 is column 3, ... TAB 79 is column 80. Each "n" must be within the range of 1 to 131.
08H	This is the backspace character. It causes the printer to print its buffer, move the print head to the extreme left, and decrement the character count by 1 (?).
09H	This is the horizontal tab character. It causes the print head to move to the next horizontal tab stop.
0DH	This is the carriage return character. It causes the printer to print its buffer, moves the print head to the extreme left, and resets the buffer character count to 0.

Print Type Commands

ESC 4	This command switches to the italics type character set.
ESC 5	This command switches to the standard character set.
ESC :	This command sets the printer to the RADIO SHACK mode. (This causes the printer to respond correctly to the TRS-80 block graphic codes.)
ESC ;	This command cancels the RADIO SHACK mode.

continued on page 36

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continued from page 33

ESC P — This command sets the compressed character print mode (printing 16.5 CPI). The maximum line size in this mode is 132 characters.

ESC Q — This command cancels the compressed character print mode.

ESC S — This command sets the expanded character print mode (printing 5 CPI). The maximum line size in this mode is 40 characters. (A carriage return cancels the expanded character print mode.)

ESC T — This command cancels the expanded character mode. (Note: ESC S ESC P together set the expanded/compressed mode of 66 characters per line.)

0EH — This character causes the rest of the line to be printed in expanded character mode (unless cancelled by a 14H).

0FH — This character causes the rest of the line to be printed in compressed character mode (unless cancelled by a 12H).

0F0EH — This character sequence (a Shift in/Shift out) causes the rest of the line to be printed in condensed/expanded mode (66 characters per inch) unless cancelled by a 1214H sequence.

11H — This character "allows the printer to receive data". I'm not sure exactly what this means, but I surmise that the printer all ready is selected and ready to receive data upon power up or reset. It is also known as DC1.

12H — This character cancels the condensed character mode. It is also known as DC2.

13H — This character de-selects the printer, and prevents it from receiving data (opposite of DC1). It is also known as DC3.

14H — This character cancels the expanded character mode. It is also known as DC4.

Enhanced Print Commands

ESC E — This command sets the emphasized printing mode. In this mode, each dot of a character is replaced by two overlapping dots.

ESC F — This command cancels the emphasized printing mode.

ESC G — This command sets the double strike mode. In this mode each character is printed twice, with the second character printed after the paper is advanced 1/216 of an inch.

ESC H — This command cancels the double strike mode.

Bit Graphics Commands

ESC J n1 n2 — This command sets the printer to the 960 resolution bit image graphics mode, but prints at the 480 resolution speed. This mode can only be used in machine language programs. Epson warns the BASIC will be unable to service the printer on time in this mode (for BASIC, use ESC L). See the discussion below for the meaning of n1 and n2.

ESC K n1 n2 — This command sets the printer to the 480 resolution bit image graphics mode.

ESC L n1 n2 — This command sets the printer to the 960 resolution bit image graphics mode.

Miscellaneous Commands

ESC 8 — This command enables paper transfer even if the printer is out of paper. This command might be useful when individual sheets of paper are being used (with a friction feed option).

ESC 9 — Cancels the paper out function (ESC 8).

ESC = — Cancels the M.S.B. function (ESC >).

ESC > — This command sets the M.S.B. function. This function forces the eighth bit to set "on" to allow access to the TRS-80 type block graphics. This command is needed for computers that only send 7 bit data (such as the Apple). This command is not needed for the TRS-80 computers.

ESC ? n1-n37 . . . This command redefines the Escape codes. (See further notes below.)

ESC @ — This command resets the printer. The printer is reinitialized to power-up settings.

07H — This character causes the bell to ring (the bell ring has been mercifully reduced to 1/3 of a second).

7FH — This is character deletes the last character input into the print buffer.

Codes not used:

ESC I, ESC M, ESC N, ESC O, ESC R.

There were two commands that I said would be discussed separately, the Bit Image Graphics modes and the Escape Code redefination. The Escape code re-definition command allows the codes to be remapped. This mapping will last as long as the printer is power-up or isn't reset. The order of the fields is:

1	1/8" line feed	20	Set form length
2	7/72" line feed	21	Horizontal tab set
3	1/6" line feed	22	Emphasized Print on
4	n/216" line feed	23	Emphasized Print off
5	Italics on	24	Double strike on
6	Italics off	25	Double strike off
7	unused	26	unused
8	unused	27	Fast 960 graphics
9	Ignore paper out	28	480 graphics
10	Cancel ignore paper out	29	960 graphics
11	TRS-80 mode	30	unused
12	Cancel TRS-80 mode	31	unused
13	Home print head	32	unused
14	Clear M.S.B.	33	Set condensed mode
15	Set M.S.B.	34	Cancel condensed mode
16	Redefine Escape codes	35	unused
17	Reset Printer	36	Set expanded mode
18	Line feed by dots	37	Cancel expanded mode.
19	Vertical tab set		

The command that sets the new codes is: ESC ? n1;n2;n3 ... n37, where each n# refers to the table code presented above. By selecting a "character" for each n# position, that character will then invoke the desired function. The sequence ESC ? A;B;C and so on would set function 1 to be "ESC A", function 2 to be "ESC B", etc. One important note: make sure that the letters or numbers mentioned are sent as character strings. If you wanted to send a carriage return, you would LPRINT CHR$(13), not LPRINT 13. The way the

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Escape sequences would be used would be LPRINT CHR$(27);"@";. (where 27 or 1BH is the escape code).

Bit Image Graphics Mode Notes

The bit image graphics mode allows you to identify and print any dot on the page. In the 960 mode, the dots are overlapped. The syntax for each of the three Bit image commands is the same. First the ESC J/K/L sequence sets up the bit image mode. This command is followed by a two character argument. The two characters together form a 16 bit integer which determines the number of characters to accept in bit image mode. The second character always indicates a multiple of 256. The first character is treated normally. There for, to determine the number of dots to be printed, use the formula Count=N1+(N2*256).

There is a little problem. According to Epson, the TRS-80 Model 1 can't send the values 0, 10, 11, or 12 to the printer. The values 10, 11, and 12 can be avoided. The problem is that 0 can't usually be eliminated. Fortunately, you can use a 255 as N2, and it will be treated as a 0. The manual includes a small routine in BASIC to allow these "illegal" values to be sent to the printer (page 19). Essentially, it bypasses the printer driver by writing the values directly to the printer I/O location 14312 (37E8H). The program must either delay to allow the value to "be sent", or test to see when the location has been reset.

It is possible to mix normal characters with the dots. The programmer must keep count of the total number of dots on the line (or else extra dots will be printed on the following line). The number of dots per character in the various modes is.

Normal (10 CPI)	6 Dots
Condensed (16.5 CPI)	3.5 Dots
Expanded (5 CPI)	12 Dots
Cond/Exp (8.25 CPI)	7 Dots

I suppose you've all been wondering how the bit graphics work. Remember that the Epson prints a 9x9 matrix? That means that 1 vertical line consists of 9 dots. The Graftrax permits you to directly address the upper 8 dots (the last dot can't be printed). Consider the following diagram:

```
Top dot.
o    128
o     64
o     32
o     16
o      8
o      4
o      2
o      1
o   can't be accessed.
```

Any vertical combination of dots can be printed by combining the different numbers.

To print every other dot starting with the top dot, use: 128+32+8+2=170.

To print every other dot starting with the second dot from the top, use: 64+16+4+1=85.

continued on page 46

BEGINNER'S CORNER: BOOK REVIEW

Spencer Koenig

Intermediate Programming for the TRS-80 (Model I), by David L. Heiserman

If you're at that awkward stage, somewhere between the beginner and the advanced BASIC programmer, or if you're one of those people who is at the edge of being bored by the limitations of BASIC and want to take that big step toward Assembly Language, here's a book for you.

For a book that's as small as it is (238 pages), it's a virtual encyclopedia of useful information. Lately, there have been a number of good books on BASIC, but none as concise as this. At times, someone might find its terseness a bit stifling, I don't. In fact I find it refreshing to have a great deal of hard, useful information for a change. The author insists that the reader get involved and use his imagination to program using the software tools given in the text. In other words, here is how it works, in some cases *why* it works, and here is a short demo. Now do something with it. By the way, the author often includes suggestions for applications.

The text is broken down into eleven chapters. They cover the various parts of the TRS-80 in great depth. The insight and knowledge that Mr. Heisermann opens up is surpassed only by his clear explanations of how the contraption works.

He is to be congratulated for this book and for his patience. He is the first author I have read who has taken the time to be so complete, in terms that an intermediate or beginner can understand. He manages to avoid being wordy or in any way too limited in scope, which would mean leaving out vital information. I define vital information as: that information you need to keep from going blank in the middle of a sentence, paragraph, or page because you didn't get the whole picture.

The point of view that Mr. Heiserman has taken can be divided into three categories. The first category deals with explanations of some of the least understood BASIC commands. From there, he uses BASIC to explain how the TRS-80 works to interpret commands and data. The last viewpoint covers applications, suggestions, and LOADS of examples to study.

I should make a point here that the book doesn't cover every command, or all the possible uses of those commands that are covered. There are a few commands and techniques I wish he would have included, but I'll get to those specifics as I go along.

Chapter One deals with the requirements of the book and the system that the book talks about. It's the shortest chapter in the book. Essentially, you need a 16K machine and some software. The author describes the use of T-BUG and EDTASM in later chapters.

Chapter Two is about "The video environment". In this chapter the reader gets a good look at the logic put into the TRS-80 design. Data representation and character codes are clearly covered. Graphic character codes and video addressing is explained in such a way that you begin to see some of the inner workings of the Mod I.

The commands covered are POKE, PEEK and PRINT @, and attention is given to relative video memory addressing and video control codes and how they function. The control codes take you to the next step—cursor control. Here, the author begins to suggest various applications, a trend he continues throughout the book.

In Chapter Three, the author talks about the "Keyboard Environment" covering the INPUT command, INKEY$, sensing key depression using the PEEK(14463) command, and, last but not least, "working with the keyboard matrix." He spends a relatively long time explaining the INKEY$ function, and I'm glad he does, because he begins to suggest applications that lead you to expanding their power to the point of imitating disk basic commands.

Chapter Four is where things start to get really exciting (at least for me). The chapter is titled "The User's Memory Environment". At this point we start to get a better glimpse of what happens when a user enters a program. I've read lots of articles and books on much of the same material but haven't seen it put together any better anywhere else. A memory map is diagrammed and, using PEEKs and POKEs, the reader sees for himself exactly what goes on when he enters a program.

The I/O buffer is demonstrated using variables, line numbers (Did you ever want to write a renumbering program or figure out how one works?) representation, compression codes of BASIC programs and how to disassemble a BASIC program in memory.

It's at this point that the author does begin to miss some important commands that I would like to have seen him explain. For example the use of the VARPTR command and how it's used in string packing. Mr. Heiserman doesn't discuss these options at all. Still, he accomplishes many of the same tasks without them.

He also discusses the function of MEM SIZE and what it actually means. However, since he has been poking around in the machine for several chapters already, he should have included something on POKEing in the MEM SIZE from a BASIC program and where one should POKE (you have to be careful about that kind of thing).

Chapter Five covers the USR function. This is clearly related to the MEM SIZE of the previous chapter showing the reader how to protect those special functions entered as machine programs. The link between BASIC and Machine code is clearly made. Mr. Heiserman gives all the needed information to pass data from BASIC to Machine code and back, giving the programmer the best of both worlds.

In Chapter Six, titled "Manipulating BASIC-loaded, USR-linked Programs," we have just that. The discussion covers the use of multiple machine programs in memory and accessing them via the BASIC USR(X) statement. We also begin to get some of the 40 plus assembly programs for study. I must say that as far as the assembler examples are

concerned they are close to being the best feature of the book. When I began programming in BASIC, the best way to begin learning was by typing in and debugging programs. All these examples are tantamount to the same approach. Type in the programs and see how they work. This chapter begins to explore how to program in general and then how to apply those same techniques to assembler code.

In keeping with this line of thought, Chapter Seven gets into the uses and functions of T-BUG. Hexadecimal representation is demonstrated using T-BUG in a hand-holding method so even the beginner will understand how to use this program. The important registers of the Z-80 chip are explained and vital information on how to crash (or not crash) T-BUG is given early in the chapter. A memory map of the program and the registers is given for the T-BUG monitor.

Chapter Eight begins the journey of exploring the TRS-80 using the T-BUG monitor in hex. This is quite good because we explore all of the same locations (video for example) that we explored before using BASIC. The user begins to get the feeling he doesn't have to fear the unknown any more. More assembly code is given to type in. The programmer is encouraged to experiment with the various modules and step through them, thereby learning how to use a relatively unsophisticated monitor little by little and learning that assembly programming is not guesswork but good planning.

Chapter Nine deals with the use and functions of EDTASM. We begin to get into the editing functions together with the basic requirements the program needs such as line numbers and how to modify them, ORG statements and END statements. And finally the reader gets to assemble his first programs, not forgetting to add plenty of comments in the source code. Something that Mr. Heiserman does very well is to explain in depth exactly what the program is doing. You can't help but feel that assembly programming is easy (watch out!!).

At about this point I feel that the book begins to fall a little short. The author doesn't really explain some of the codes and types of addressing he uses. I think it wouldn't have added much text to explain, simply, the differences in the various load instructions and the types of addressing modes they use. He does make the point that his book was not intended to explain assembly language in all its detail but considering the depth he goes to to explain EQUATEs, the various DEF-type label statements etc, he could have been as thorough regarding LOADs, FLAGs, and various other reserved assembly words.

Chapter Eleven and the following appendices are essentially more demonstrations of putting the whole package together, including explanations about number-base conversions, general graphics routines and a Z-80 assembly code listing. All in all, I feel that this is a terrific book that belongs on every programmer's shelf. If I had to give it a rating, on a scale of 100, I would say this belongs in the 90th percentile for clarity. It definitely fills an important gap for the intermediate programmer.

Spencer Koenig
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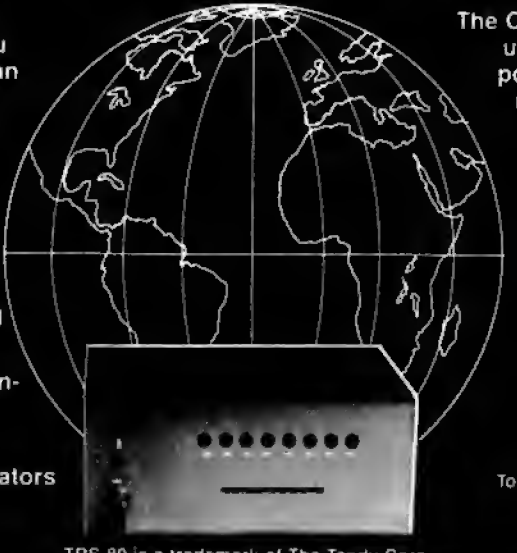

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COLOR COMPUTER CORNER

Joseph Rosenman

This Month: Spectaculator and Space War

I'm going to start this month's column with a review of a major program from Radio Shack: Spectaculator (Catalog number 26-3104). Spectaculator is a special version of Visicalc for the Color Computer. First, the specifics:

System requirements: 4K, 16K, or 32K system.
Supplied on: ROM pack.
Disk compatible: unknown (probably not).
Price: $39.95

I have one big question: Why did they call the program "Spectaculator" instead of "Visicalc?" Is it supposed to be a "spectacular" calculator rather then merely a "visible" calculator? Only Tandy knows (who is this Tandy character anyway?). Maybe the spectacle is in watching the novice user trying out the program for the first time! My guess is that the color is the "spectacular" part. Needless to say, the "color" aspect of this program is superfluous. It adds some contrast, and helps distinguish different modes of the program, but isn't really necessary. Does EVERY program on the color computer have to capitalize on the "color" aspect? The answer is (and should be) an emphatic no. This is a computer that happens to have special color capabilities, but this (and any other computer system) should be able to perform a multitude of different applications.

What about Spectaculator? What is Visicalc? Visicalc (or Spectaculator) is a "spread sheet calculator." You are provided a matrix (a matrix is an array with two dimensions), with a maximum size of 99 by 99. Each point in the matrix (known as a "cell") can be accessed through the use of the arrow keys. A cell can be used to contain a numeric value or a text message. This "spread sheet" can be saved to or read from a cassette. Any portion of the matrix can be printed (Spectaculator only supports an 80 column print format). Certain arithmetic calculations can be performed between specified cells, and results stored in specified cells. Unfortunately, calculations can only be performed by row or by column, not both together. Of course, since every cell is a part of both a row and a column, two calculations together will combine the information in both a row and a column. Several rows with several columns would require multiple calculations.

Spectaculator Command Summary

MM — Move Marker to a specified cell location (by row and column).
EN — Enter numbers mode.
CF — Column formula: associates a specific formula or expression with the current column.
RF — Row formula: associates a specific formula or expression with the current row.
CA — Calculate: perform any Row and/or Column calculations (previously entered by the CR or RF commands).
ET — Enter text into the current cell.
CR — Clear current row.
CC — Clear current column.
CW — Change column width: Width is variable from 2 to 27 characters wide (default is 7).
FR — Free memory display.
DR — Delete row (all rows below are shifted up by one).
DC — Delete column (all columns to the right are shifted left by one).
IR — Insert row (all rows below are shifted down by one).
IC — Insert column (all columns to the right are shifted right by one).
SA — Save on tape.
LO — Load from tape.
LI — List to printer.

Break returns you to command mode (and cancels the current command).
Clear acts as the backspace key.
Shift/Clear cancels the current command line.
Typing a question mark (?) will cause a help display to appear. Typing "?" from command mode displays a menu of possible commands. Typing "?" while in a specific mode causes a brief description to appear, usually with relevant examples.

Even though the fields can be as large as 27 characters wide, numeric values are limited to 9 digits (with a maximum fraction of 5 digits). By the way, it is not necessary to set all of the columns to the same width; they can be varied freely.

The row and column calculation feature provides a reasonably flexible and useful facility. Any given combination of rows or columns can be operated upon. Results can be either Integer or Decimal. Along with the standard operators (addition, subtraction, multiplication, and divison), Spectaculator permits parentheses to determine the order of precedence in the decoding of the command. There are also three functions: SQR, SUM and SMT. The Square root and Summing functions are standard. SMT stands for "summation." This function provides cumulative totals along with the "final" summation.

Is It Worth It?

Yes. This is a quality program that could prove itself to be invaluable in the proper applications. It works very quickly, and is reasonably easy to use. The "help" feature is especially noteworthy. The instruction manual is well written and complete. It includes several examples of how the Spectaculator program might be used. Be prepared to "slip up" as you get started. Several practice sesssions are definitely required. Any suggestions for improvement? Sure, add an auto-repeat function to the keyboard driver. Except for that, Radio Shack gets a big gold star for this one.

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SPACE WAR

from: Spectral Associates
141 Harvard Avenue
Tacoma, WA 98466
(206) 565-8483

System requirements: 16K non-extended or extended BASIC.
Supplied on: Cassette. Joysticks required.
Disk compatible: probably.
Price: $21.95

Space War is a machine language game that uses the highest resolution graphics mode on the color computer. My review of this program is mixed. There are several problems with this program that I find fairly serious. On the other hand, the program offers several unique features, and it is very challenging.

The game has 16 levels of play. The screen (which is black) contains 1 black hole, 1 death star, four space mines, a roving asteroid, and your ship. The screen is dominated by the black hole and the death star. The goal of the game is to score as many hits against the death star and the mines as is possible, without getting pulverised. The position of the ship, the speed it moves, and the missile firing are controlled by the joysticks. The explosions from the missiles are colorful and spectacular. Warning: the game is difficult. The black hole has enough gravity to trouble any star ship commander. Those nasty space mines are invisible (until you stray close enough to trip their explosion mechanisims). What's more, the death star has a rotating shield with only 1 small opening. Even at the easiest speed, things move VERY fast. You get one little assist: their is a special "cloaking" device (with limited power) that protects your ship from enemy attack (one little hitch, although the cloak prevents incoming missiles from destroying you, you can't shoot your missles throuh it!).

Now for the bad side. First of all, your spaceship is very small and is extremly hard to see. In fact, everything except the meteor, death star, and black hole are small. As if that isn't enough, the sound is really pathetic. To be fair to Spectral associates, they explain the reason for the poor sound. The reason presented is that the game requires continuous CPU servicing. Sound routines require a lot of CPU time. Given the choice of elegant sound or high quality graphics, Spectral Associates chose the graphics. It is an unfortunate fact that such a choice had to be made, but I believe the correct choice was made. There IS some validity to their reason. I must add, however, that similar problems existed with the Model 1 (which isn't even supposed to produce sound). Anyone who is familiar with Big Five games or Dancing Demon knows just what can be done with sound and simultaneous graphics. Well, let's give them time.

Summary: Space War is a fast action arcade game that most Color Computer users will find quite challenging. Despite the limitations mentioned in this review, the game

continued on page 53

POCKET COMPUTER CORNER

Steven M. Zimmerman, Ph.D. and Leo M. Conrad

A General Ledger Program for the Pocket Computer

Copyright © Zimmerman and Conrad 1982

In our first book on the pocket computer we said its use in the accounting area was questionable. We decided to ask the question in depth relative to a general ledger program and found we could write such a program which was very satisfactory for some small businesses. The general ledger routine we developed will handle a chart of accounts of up to 40 items with no limits on the number of transactions. It will produce a trial balance, a listing of transactions, an income and expense statement, and a balance sheet. The formats the output on the computer's display and printer are not exactly what most accountants would want but the information is produced. The routines all assume printer output when output is produced.

There is no question a large microcomputer can do a better job in the field of accounting than the pocket computer. There is no question a large mainframe computer can do an even better job. We believe there are certain size accounting problems for which the pocket computer and our general ledger program is a good fit.

Accounting systems can be designed for individuals with different levels of accounting abilities. Ours assumes the user knows the difference between a debit and a credit. An individual with six months of business experience in bookkeeping, or a single college level accounting course, or a couple of high school courses should have adaquate accounting background to use our program. We will assume that you, the reader has this background and does not need a review of the double entry system of accounting before using the program. No background material has been included in this article.

RUNNING THE PROGRAM

There are five routines in the program. These are:

TRANS
TRIAL
CLOSE
START
ZERO

You select the routine by typing RUN "name" in either the RUN or DEFinable MODEs of your computer. The TRANSaction routine may be called by typing RUN alone since it is the first routine in our coding. There is no memu. We eliminated the menu to keep the number of items in the chart of accounts as high as possible.

The TRANSaction routine is designed to input periodic transactions for income and expense which occurs in the business. The TRIAL balance routine is designed to tell you the status of all your accounts at any time. You may put in a small number of transactions, run the trial balance routine, and then return to the task of inputting transactions.

The CLOSE routine produces an income and expense statement, and a balance sheet. This routine terminates a series of transactions and closes the income and expense accounts to retained earnings or surplus or whatever name you wish to use for this account. All account names are under the control of the user.

The START routine is used to name each item in the chart of accounts and to input their initial values. The routine should seldom be used for any given company. The chart of accounts should be carefully planned with your accountant's help and extra charts left for expansion if needed.

The ZERO routine is used to zero the values for all items in the chart of accounts. We found this routine very useful while the programs were being written. We believe it will be of value to a bookkeeper or accountant who is using the pocket computer and general ledger program for a series of different businesses. If you do not need this routine leave it out and you will be able to increase the number of items in your chart of accounts slightly.

After you use ZERO to zero out the values in your chart of accounts you may use use TRANS as a single entry input device to input the initial values for a new business. If the chart of accounts is small we believe this will work well. If the chart of accounts is larger we suggest you use your cassette recorder to save the values for individual companies and reduce the transfer of initial information problem.

We will review how each of the routines are to be used. So as to have an example available to work with we will start with START and input a chart of accounts with some initial values.

RUN "START"

Before we can start putting in a chart of accounts we need to define the one we wish to use. The following 12 item chart of accounts complete with initial values was selected for our example.

CHART of ACCOUNTS

	DEBIT	CREDIT
1.CASH	2Ø72.87	
2.HOUSE	34ØØØ.ØØ	
3...RES DEP		1ØØØ.ØØ
4.SALES		Ø.ØØ
5.MAINTENANCE		Ø.ØØ
6.DEPRECIATION		Ø.ØØ
7.RENT		Ø.ØØ
8.INTEREST		Ø.ØØ
9.MORTGAGE		29626.32
1Ø.ACCT PAYABLE		48Ø.Ø9
11.CAPITAL		3ØØØ.ØØ
12.SURPLUS		1966.46

You will notice we have typed all zero account values as credit values. This is the output procedure used in our program and we wanted to be consistent in the manner in which we did things. We used SURPLUS, the old word for retained earnings because it better fit the seven character limit the pocket computer places on the names in the chart of accounts. RETAINE makes less sense to us than SURPLUS. The user selects the names to be used with the seven digit limit.

By typing RUN "START" in the RUN or DEFinable MODEs the START routine is called in. The first thing it does is to clear everything which was in memory. Do not call in this routine unless you really wish to use it.

After typing RUN "START" and hitting the ENTER key you will see:

```
NO IN CHART?
```

This question refers to the number of items in the chart of accounts. We have specified 12 so type 12 and hit ENTER.

```
NO? 1.
NAME?
```

The NO? 1. will be flashed on the display and then the question name will wait for an answer. Account number one is the CASH account so type CASH and hit ENTER.

```
DEBIT/CREDIT?
```

The cash account has a debit balance of 2072.87. Type DEBIT as the answer to the above question and hit ENTER.

The next question is:

```
AMOUNT?
```

Since the amount in this account is $2072.87 type 2072.87 and hit ENTER.

The questions will repeat themselves until you have entered all items in the chart of accounts. It is necessary to have all items which will be in the income and expense statement together. For example, in our sample run the first item in the income/expense statement is the 4. SALES account and the last item is 8. INTEREST. All items in the chart of accounts from 4 to 8 inclusive are income/expense items.

After you have completed the input of the chart of accounts, the computer is ready to recieve additional instructions.

RUN "TRIAL"

In order to check if we have inputted the chart of accounts correctly, the TRIAL balance routine is run. The program starts by printing TRIAL BALANCE on the printer. On the display the first thing you will see is:

```
DATE?
```

We answered with DEC 82 for our data. Remember there is a limit of seven characters. The computer will print the date on the printer and ask the next question:

```
NAME?
```

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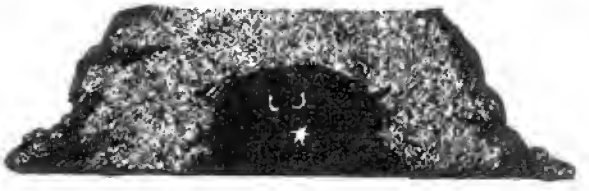

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We use the name CO X for the name of our company in the sample run. After typing CO X and hitting the ENTER key the computer produces the trial balance. Listed below is the trial balance as produced on our printer with the initial title information included:

```
TRIAL BALANCE
DEC 82
CO X

ACCOUNT DEB/CRE
1.CASH 2Ø72.87
2.HOUSE 34ØØØ.
3...RES D
         1ØØØ.
4.SALES
            Ø.
5.MAINTEN
            Ø.
6.DEPRECI
            Ø.
7.RENT
            Ø.
8.INTERES
            Ø.
9.MORTGAG
       29626.32
1Ø.ACCT PA
        48Ø.Ø9
11.CAPITAL
       3ØØØ.ØØ
12.SURPLUS
       1966.46
------ --------
       36Ø72.87
       36Ø72.87
====== ========
```

The format of our 16 column printer does not do a super job with the debit/credit line up problem. We have printed the debits on the same line as the headings as near to the names as possible while the credits are printed on the line following the name. This technique does the job of identifying which are debits or credits. As noted earlier, all accounts with zero balances have the value printed out as if it were a debit balance. If you want to change this we will tell you how when we review the coding.

At the end of the trial balance are printed two single lines, the debit balance followed by the credit balance and then two double lines. You will note the sum of the debits is equal to the sum of the credits.

We do not have an error correcting routine to correct individual items for spelling or other keystroke errors. The reason we did not include such a routine was to maximize the number of items in the chart of accounts, and there is another way to make corrections on your pocket computer.

Making Individual Value Corrections

If you want to find an idividual item you may do so. For example, item 9. MORTGAG has its name stored in location 10 plus 9 and its value stored in location 10 plus 9 plus 12. The 10 comes from the fact we have used the first ten characters only for our variable names. The nine comes being 9, and there are 12 items in the chart of accounts.

Type A$(19) and hit ENTER to see the word MORTGAG and type A(31) and you will see -29626.32. If you wish to change the word stored in location 19 type A$(1))="new name" and hit ENTER. You have now corrected the name. (The reason for the "$" is to tell the computer you are inputting or outputting a string variable).

To correct a value you must know its location and whether it is a debit or credit value. Debit values are inputted as positive numbers while credit values are inputted as negative numbers. The fact A(31) is negative tells us and the computer the value is negative. To change the value of MORTGAG to $5000.00, you would type A(31)=-5000.00 and hit the ENTER key.

The only time we suggest using direct input to make corrections is for the name of an item in the chart of accounts or at the beginning when the system is first being set up. For all other corrections we suggest the use of single unbalanced entries using the TRANSaction routine. The reason for this approach is that a record of the corrections can be made and the accounting audit trail will be maintained.

RUN "TRANS"

To illustrate how transactions are placed into our general ledger program we need a set of sample transactions. Below are the transactions we used:

1.Paid an outstanding bill for $52.60
2.Sold and collected $4104.60 for goods/services
3.Purchased an addition to the building of $9,000. Paid $1000 cash down and added $8,000 to the original mortgage.
4.Made a mortgage payment of $536.50, $500 was reduction of loan while $36.50 was interest expense.
5.Depreciation for the period was $1200.
6.Paid for maintenance $566.77.

To place the transaction into the computer we start by typing RUN "TRANS" or just RUN in the RUN or DEFinable MODEs. As noted earlier the reason we can get away with just typing RUN into our computer is this is the first routine in the machine.

After hitting ENTER the first thing that happens is:

```
ACCT DEB CRE/AMT
DEB CRE?
```

Is printed on the printer and the following appears on the computer's display:

```
ACCT DEB CRE?
```

This question is asking us to input the account to be debited and then when we see the next question mark the account to be creditied. For the first transaction, paying $52.60 we debit accounts payable account number 10 and credit cash account number 1.

The next question is relative to the amounts to be

debited and credited.

```
AMT DEB CRE?
```

This question also asks for two numbers to be put in one at a time. In this case 52.6 must be typed in twice. As soon as the transaction is complete the tranaction is printed on the printer and posted. A listing of all the transactions needed for our sample set follows:

```
1Ø. 1. 52.6 52.6
1. 4. 41Ø4.6 41Ø
4.6
2. 1. 9ØØØ. 1ØØØ
.
2. 9. Ø. 8ØØØ.
8. 1. 36.5 536.5
9. 1. 5ØØ. Ø.
6. 1. 12ØØ. 12ØØ
.
1. 3. 12ØØ. 12ØØ
.
5. 1. 566.77 566
.77
```

There were a number of transactions requring multiple entries in our selection. The first was relative to the purchase of an addition to the building. This transaction took two lines. The first line input the increase of value in the building and the cash expenditure, the second line input the increase in liability relative to the outstanding mortage.

Paying the mortgage took two lines also due to the need to allocate part of the dollars spent to interest expense and part to the reduction of the loan.

The depreciation transaction also took two lines due to a typing error. The keys on the pocket computer are small and even if they were not we would still make our share of errors. The first transaction credited the depreciation from cash instead of depreciation expense, the second transaction corrected the error. The last transaction was a straight foward debit to maintenance expense and a credit to cash.

To terminate the TRANSaction program simply hit the ENTER key without inputting any data.

Now that the transactions are entered a trial balance is called for to see if any errors were made. RUN "TRIAL" resulted in the following:

```
TRIAL BALANCE
JAN 83
CO X

ACCOUNT DEB/CRE
1.CASH 4Ø21.6
2.HOUSE 43ØØØ.
3...RES D
         22ØØ.
4.SALES
        41Ø4.6
5.MAINTEN 566.7
7
6.DEPRECI 12ØØ.
7.RENT
            Ø.
8.INTERES 36.5
9.MORTGAG
       37126.32
1Ø.ACCT PA
         427.49
11.CAPITAL
        3ØØØ.ØØ
12.SURPLUS
        1966.46
------ --------
       48824.87
       48824.87
======= =======
```

We still have a balanced trial balance so we did not make any errors in the sum of the debits and credits. We are now ready to close the books for the period.

RUN "CLOSE"

Warning *** once this program is run, the original information relative to the trial balance is lost. After typing RUN "CLOSE" you will asked the date:

```
DATE?
```

We used JAN 83 which was printed on the printed followed by a request for the company's name. We typed CO X, nd after that was printed we were faced with the following question:

```
1ST SALES?
```

This question wants to know the account number for the first item in the income and expense report. This is four in our example (4. SALES).

After inputting 4 the next question is:

```
LAST EXP?
```

In this case the computer wants the last item of expense. In the example eight, 8. INTERES is the last item.

The computer prints out:

```
INCOME/EXPENSE
```

and proceeds to the next question relative to the number of the retained earnings or surplus account.

```
SURPLUS?
```

Twelve, 12, is the number of this account so we type 12 hit ENTER and obtain the following results:

```
4.SALES
   41Ø4.6
5.MAINTEN 566.7
7
6.DEPRECI 12ØØ.
7.RENT
       Ø.
8.INTERES 36.5

PROFIT:$23Ø1.33
```

```
ACCOUNT DEB/CRE
1. CASH 4021.6
2. HOUSE 43000.
3. ..RES D
     2200.
9.MORTGAG
       37126.32
10.ACCT PA
   427.49
11.CAPITAL
  3000.00
12.SURPLUS
  4267.79
------ --------
  47021.6
  47021.6
====== ======
```

The income and expense statement is output first and labeled. The balance sheet is output second and does not have a label. Again we minimized the labels in order to maximize the number of items in the chart of accounts. The balance sheet does balance after the income and expenses were closed. If you want, you can now print a new trial balance which is ready for the next period.

RUN "ZERO"

This routine may not be needed by everyone. By typing RUN "ZERO" all values in the chart of accounts are set at zero. This routine is useful to individuals using a given chart of accounts for more than one concern.

REVIEW OF THE PROGRAM

We have used line numbers to structure the program. Lines 10 through 13 are the TRANSaction routine. The routine is so identified in line 10. Lines 20 through 26 is the TRIAL balance routine. This routine is identified in line 20. The "name" identification at the beginning of the routine is what the computer uses to find the routine being called for in the RUN instruction.

Line 30 is identified with the word "CLOSE", line 50 with the word "START", and line 60 with the word "ZERO" for the remaining three routines. For those who do not need the ZERO routine you may skip copying this line.

If you wish your zero balances to be printed as a debit rather than a credit you must make the format in line 23 match the format in line 22. Remove the last :PRINT and replace it with a " ";.

PROGRAM LISTING

```
10:"TRANS"PRINT "ACCT DEB CRE/AMT DEB CRE"
11:INPUT "ACCT DEB CRE?";B:INPUT C:INPUT "AMT DEB CRE?";D:
   INPUT E:GOTO 13
12:END
13:PRINT B;% ";C;% ";D;% ";E:A(10+C+A)=A(10+C+A)-E:
   A(10+B+A)=A(10+B+A)+D:GOTO 11
20"TRIAL"PRINT "TRIAL BALANCE":INPUT "DATE?";B$:PRINT B$
   INPUT "NAME?";B$:PRINT B$:PRINT % ":J=0
21:PRINT "ACCOUNT DEB/CRE":E=0:F=0
22:FOR B=1TO A:G=B+A+10:H=B+10:IF A(G)>0PRINT B;% ";A$(H);
   % ";A(G):E=E+A(G)
23:IF J=0IF A(G)>=0LET I=-A(G):PRINT B;% ";A$(H):PRINT I
24:IF A(G)<=0LET I=-A(G):PRINT B;% ";A$(H):PRINT I:
   F=F-A(G)
25:NEXT B:PRINT "------- --------":PRINT E,F:PRINT "
   ========= ======="
26:END
30:"CLOSE"INPUT "DATE?";B$:PRINT B$:INPUT "NAME?";B$
   PRINT B$:J=9
31:INPUT "1ST SALES?";B:INPUT "LAST EXP?";C:PRINT "
   INCOME/EXPENSE":F=0:INPUT "SURPLUS?";H
32:FOR D=-BTO C:G=D+10:E=G+A
33:IF A(E)>0 PRINT D;A$(G);% ";A(E)
34:IF A(E)<=0 PRINT D;A$(G):PRINT -A(E)
35:F=F+A(E):A(E)=0:NEXT D:A(H+A+10)=A(H+A+10)+F:
  PRINT "2 ":F=-F:PRINT PROFIT:$;F:PRINT % ":GOTO 21
50:"START"CLEAR:INPUT "NO IN CHART?";A
51:FOR B=1TO A:E=B+10:PAUSE "NO?";B:INPUT "NAME?";A$(E):
   INPUT "DEBIT/CREDIT?";C$:INPUT "AMOUNT?";D
52:IF C$="CREDIT"LET D=-D
53:A(A+10+B)=D:NEXT B
54:END
60:"ZERO"FOR B=11TO 2A+11:A(B)=0:NEXT B:END
```

SUMMARY

Our general ledger for the pocket computer proves that this computer may be used at least for this accounting function for small companies. The general ledger routine we developed handles a chart of accounts of up to 40 items with no limits on the number of transactions. It produces a trial balance, a listing of transactions, an income and expense statement, and a balance sheet. The format of the output on the computer's printer is not good, but the information is produced. The printer is best used for this program.

The accounting system is designed for individuals with some accounting background. Even the pocket computer cannot eliminate the need to know and understand the accounting theory being used.

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P.O. Box 9843
Mobile, Alabama 36691-0843 ■

EPSON GRAFTRAX

continued from page 37

To print only the top four dots, use 128+64+32+16=240.

To print only the bottom four dots, use 8+4+2+1=15.

To print all of the dots except the two middle dots, use 128+64+32+4+2+1=231.

To print only the bottom dot, use 1.

The pin settings I have found most effective are:

RECORDS AND FILES

Gordon Speer

When you write programs using sequential or random files to store data, it is helpful to have similar programs handy to refer to for statement order, syntax, and structure. It was with this idea in mind that these four versions of the same program were written. Using these examples, and referring to the differences between them, even those of you who have not yet attempted file writing should be able to progress into this area.

Suppose your local travel agent asks you to write a program which will give the destination and time of departure for airline flights, when the flight number is keyed in. How would you go about writing such a program? I have, first of all, limited the flight numbers to integers between 1 and 500. You will notice that the programs contain only 11 examples which, in each case, are in the form of data statements. In actual practice you could easily put 500 lines of data in the program, provided your RAM (random access memory — 16K, 32K, 48K) can contain them.

The first two programs will operate on TRS-80 microcomputers without disk drives. In the first program, when the flight number is keyed in, the data statements are searched until the flight number is found, and then the corresponding city and time are displayed. If you have 500 flights in the data this will require about ten seconds, really quite a long time to wait if you are busy.

A much faster method is used in the second program, SCHEDULE/SUB. Here the data are read into an array in the memory in which the index number or subscript is the flight number. Subscripts must be integers, zero or larger, but may be quite large. Note that the dimension statement in line 120 "introduces" the variable which will be subscripted to allow the computer to set aside space for the array. The subscript in the dimension statement is the largest one you will use, not the number of them. Each time the program is run the data become the elements of the array, indexed by subscripts which, in this program, are the flight numbers. When a flight number is entered, the element which has that subscript is printed. This program is by far the fastest of the four. Access to arrays in memory is almost instantaneous.

The principal advantages of disk drives are the greater storage capacity (50K to 175K per diskette), and the ease and speed of making copies. The first thing the program SCHEDULE/SEQ does is to write the sequential file FLIGHTS/SEQ. It is rather straightforward, except for the last comma in line 310, which must be written into the sequential file to indicate the point where the city name ends and the departure time begins. Without this comma the two strings would be read back as a single string. No

EPSON GRAFTRAX

continued from previous page

	Switch 1		Switch 2	
	off	on	off	on
1	x			x
2		x		x
3		x		x
4	x			x
5	x			
6		x		
7		x		
8		x		

This setup includes the slashed 0 print, where everything else is standard. If you are going to use the Electric Pencil (with the Epson cable), this setting will work fine. For use with BASIC, change dip switches 2 and 3 to the "OFF" position. The above switch settings show how the dip switches should look as you face the back of the printer.

So, that's the Graftrax option. If you have an EPSON MX-80 printer, I strongly recommend that you purchase the Graftrax modification. You will gain a great deal of additional control over your printer, while losing very little (mainly, the Katakana characters). The Graftrax option can be purchased from many different dealers, or directly from Epson America, Inc. The list price for the Graftrax option is $99.00, although I have seen it available at a discounted price.

Joseph Rosenman
35-91 161 Street
Flushing, New York, 11358 ■

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comma is needed at the end of that line, since the line feed generated by the lack of a line control character, itself serves as a delimiter. (If you understand this, you are already an expert. If not, read it a few more times. It really does make sense.) The sequential files written on a disk are read from the beginning, somewhat like the data statements in the first program, until a matching flight number is found. If the entire file is read and no matching number is found, the EOF(X) end-of-file marker for buffer #X is reached and the error message is displayed. Access time will depend on how far into the file the correct record is stored, a minimum of 3 seconds, maximum perhaps 30 seconds.

At this point, if you have run the sequential file program and written the file FLIGHS/SEQ, you should learn how to LIST and PRINT sequential files in the disk operating system. Return to TRSDOS by using the reset button or CMD"S", and type: LIST FLIGHTS/SEQ (enter) and the entire file will be displayed on your video display. PRINT FLIGHTS/SEQ (enter) will output the file on your line printer, if you have one. This is a super feature for making hardcopy records of sequential files.

The last program is SCHEDULE/RAN. This uses subsectored random files like the COINS program in the JUNE 1982 issue. Random files which have fixed lengths of 256 bytes waste a lot of useful space when storing short records, unless you store more than one record in each sector (1 sector=256 bytes). This requires a little finesse, but all of that is contained in the 4 subroutines at the end of the program.

The first subroutine OPENS the file, finds out how many sectors it contains (LOF(1)), asks how many records there are in the last sector (Z), and calculates the total number of records in the file (N). The second subroutine uses the current record number (R) from your program to determine which sector (S) to GET it from, and how many records to skip over in the process (K%). The FIELD statement in line 640 shows that there are 28 bytes in each record, 20 of which contain the city name, and 8 the departure time. The third subroutine is used to GET sector S, LSET record R into it, skipping over K% records in the process, and PUT the entire sector back into the file. The fourth and final subroutine determines how many records there must be in the last sector (Z) and writes that number in the last byte of that sector before closing the file. In this way when the file is opened again the total number of records (N) can easily be determined. Before I learned to do this I used to have blank records interspersed in my files.

Curiously, K%, the number of records skipped, must not only be an integer, but must carry the integer sign (%) in line 640, the FIELD statement. Defining it as an integer at the beginning of the program won't work. This is a little flaw in DOS 2.3 which may be corrected someday. To determine how many records you can have per sector, you simply divide the length of the largest record into 255. I wanted 28-byte records, so I get 9 in each sector. The reason you divide into 255 and not 256, is that the 256th byte in the last sector is used to keep a count of the number of records in that sector. I worried about wasting that byte in each sector until I realized that the only numbers of records per sector which divide into 256 evenly, are 2, 4, and 8. With 3, 5, 6, 7, and 9 records per sector the last byte wouldn't be used anyway. With a single-density Model-I disk in drive #1 using 35 tracks to store 28 byte records at 9 per sector, you can store and retrieve 3150 records in one file. Accessing records in a random file consists of entering the number of the record (line 360), getting the record out of the file (line 390), and displaying it on the screen (line 420). Total time required: about 5 seconds.

If you have any questions, feel free to write or phone. Please enclose a stamp if you write, or phone between 9PM and 10PM, 1-815-625-5251.

PROGRAM LISTING

```
1ØØ '   SCHEDULE        DATA SEARCH VERSION
11Ø CLEAR 5ØØ                    'STRING SPACE
12Ø DATA 1,HONOLULU,8 3Ø AM
13Ø DATA 14,CLEVELAND,9 Ø5 AM
14Ø DATA 27,NEW YORK,1Ø 15 AM
15Ø DATA 77,ALBANY,11 Ø5 AM
16Ø DATA 155,MIAMI,11 3Ø AM
17Ø DATA 295,MEMPHIS,12 Ø5 PM
18Ø DATA 382,DENVER,1 Ø5 PM
19Ø DATA 444,CHICAGO,2 25 PM
2ØØ DATA 488,DALLAS,3 45 PM
21Ø DATA 499,SEATTLE,5 55 PM
22Ø DATA 5ØØ,LOS ANGELES,7 3Ø PM
23Ø DATA Ø,DUMMY,DATA
24Ø '
25Ø CLS                          'CLEAR THE SCREEN
26Ø INPUT "FLIGHT NUMBER";N
27Ø RESTORE     &                'GO TO THE BEGINNING OF DATA
28Ø READ R,C$,T$                 'RECORD NUMBER,CITY,TIME
29Ø IF R=Ø THEN 33Ø              'OUT OF DATA
3ØØ IF R <> N THEN 28Ø           'WRONG ONE - KEEP LOOKING
31Ø PRINT C$;" - ";T$            'DISPLAY THE ANSWER
32Ø GOTO 34Ø                     'SKIP THE ERROR MESSAGE
33Ø PRINT "NO FLIGHT BY THAT NUMBER"
34Ø PRINT
35Ø GOTO 26Ø                     'CYCLE

1ØØ 'SCHEDULE/SUB        SUBSCRIPTED ARRAY VERSION
11Ø CLEAR 1ØØØØ                   'STRING SPACE
12Ø DIM F$(5ØØ)                   'DIMENSION THE ARRAY
13Ø DATA 1,HONOLULU,8 3Ø AM
14Ø DATA 14,CLEVELAND,9 Ø5 AM
15Ø DATA 27,NEW YORK,1Ø 15 AM
16Ø DATA 77,ALBANY,11 Ø5 AM
17Ø DATA 155,MIAMI,11 3Ø AM
18Ø DATA 295,MEMPHIS,12 Ø5 PM
19Ø DATA 382,DENVER,1 Ø5 PM
2ØØ DATA 444,CHICAGO,2 25 PM
21Ø DATA 488,DALLAS,3 45 PM
22Ø DATA 499,SEATTLE,5 55 PM
23Ø DATA 5ØØ,LOS ANGELES,7 3Ø PM
24Ø DATA Ø,DUMMY,DATA
25Ø '
26Ø READ R,C$,T$                  'RECORD NUMBER,CITY,TIME
27Ø IF R=Ø THEN 3ØØ               'OUT OF DATA
28Ø LET F$(R)=C$+" - "+T$         'ASSEMBLE DATA - STORE ARRAY
29Ø GOTO 26Ø                      'GET ANOTHER RECORD
```

```
300 CLS                          'CLEAR THE SCREEN
310 INPUT "FLIGHT NUMBER";R
320 IF R<1 OR R>500 THEN 310     'RECORD NUMBER OUT OF RANGE
330 IF F$(R) < "A" THEN 360      'VACANT ELEMENT IN THE ARRAY
340 PRINT F$(R)                  'DISPLAY THE RECORD
350 GOTO 370                     'SKIP THE ERROR MESSAGE
360 PRINT "NO FLIGHT BY THAT NUMBER"
370 PRINT
380 GOTO 310                     'CYCLE

100 'SCHEDULE/SEQ       SEQUENTIAL DISK FILE VERSION
110 CLEAR 10000                  'STRING SPACE
120 INPUT "HAS FILE BEEN WRITTEN";Q$
130 IF LEFT$(Q$,1)="Y" THEN 330
140 '           WRITE THE DATA INTO SEQUENTIAL FILE
150 DATA 1,HONOLELU,8 30 AM
160 DATA 14,CLEVELAND,9 05 AM
170 DATA 27,NEW YORK,10 15 AM
180 DATA 77,ALBANY,11 05 AM
190 DATA 155,MIAMI,11 30 AM
200 DATA 295,MEMPHIS,12 05 PM
210 DATA 382,DENVER,1 05 PM
220 DATA 444,CHICAGO,2 25 PM
230 DATA 488,DALLAS,3 45 PM
240 DATA 499,SEATTLE,5 55 PM
250 DATA 500,LOS ANGELES,7 30 PM
260 DATA 0,DUMMY,DATA
270 '
280 OPEN "O",1,"FLIGHTS/SEQ"
290 READ R,C$,T$                 'RECORD NUMBER,CITY,TIME
300 IF R=0 THEN 330              'FINISHED READING DATA
310 PRINT #1,R;C$;",";T$         'WRITE COMMA TO SEPARATE STRINGS
320 GOTO 290                     'READ ANOTHER RECORD
330 CLOSE 1
340 '           LOOK UP FLIGHTS IN SEQUENTIAL FILE
350 CLS                          'CLEAR THE SCREEN
360 INPUT "FLIGHT NUMBER";N
370 IF N<1 OR N>500 THEN 360     'OUT OF RANGE
380 OPEN "I",1,"FLIGHTS/SEQ"
390 IF EOF(1) THEN 450           'REACHED END OF SEQUENTIAL
FILE
400 INPUT #1,R,C$,T$             'READ A RECORD FROM FILE
410 IF R=N THEN 430              'THAT'S THE RIGHT ONE
420 GOTO 390                     'TRY ANOTHER ONE
430 PRINT C$;" - ";T$            'DISPLAY THE RECORD
440 GOTO 460                     'SKIP OVER THE NEXT LINE
450 PRINT "NO FLIGHT BY THAT NUMBER"
460 CLOSE 1  :PRINT
470 GOTO 360                     'CYCLE

100 'SCHEDULE/RAN       RANDOM DISK FILE VERSION
110 CLEAR 10000                 'STRING SPACE
120 INPUT "HAS FILE BEEN WRITTEN";Q$
130 IF LEFT$(Q$,1)="Y" THEN 350
140 '          WRITE DATA INTO RANDOM FILE
150 DATA 1,HONOLULU,8 30 AM
160 DATA 14,CLEVELAND,9 05 AM
170 DATA 27,NEW YORK,10 15 AM
180 DATA 77,ALBANY,11 05 AM
190 DATA 155,MIAMI,11 30 AM
```

continued on page 56

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For the TRS-80 Model I/III (48K, 2 disk drives, lower case required). Available at your favorite software store, or order from **Software Options,** 19 Rector Street, New York, N.Y. 10006. 212-785-8285. **Toll-free order line: 800-221-1624.** Price: $125 (plus $3 per order shipping and handling). New York State residents add sales tax. Visa/ Mastercard accepted.

SOFTWARE OPTIONS INC™

MONTHLY EXPENDITURE INFORMATION PACKAGE

Bill O'Neill

This set of programs will file, retrieve, and report personal monthly information, in a "data processing" manner. This package consists of four BASIC programs and two data files. These programs and data files interact to provide historical financial information to the user of a disk-based Model 1 or Model 3 system. The programs have been written to allow a maximum amount of flexibility in terms of modification. They are intended to give the user a framework on which to develop programs to meet his or her own specifications, while serving as a completely workable package as it is currently written.

To Initialize this program, run the MSTEX program. MSTEX will initialize the data file EXPEN/DAT. This will be the only time that MSTEX is run directly. At each month end this program will be accessed indirectly through the UPDATE program. Whenever this program package is used thereafter, it will be through UPDATE. UPDATE accesses the other programs in the package (MSTEX, MONTHRE, and REPORT), and provides for all data entry. UPDATE will use the data file EXPEN to store the expense information. The other data file is MONTHTOT/DAT, which will store the past months totals. The program is entirely menu driven and doesn't require any special instructions.

As mentioned earlier, many modifications and expansions can be made to this package. Possible modifications could include: computing the mean and standard deviation for each catagory per month; designing a program which will graphically represent the data in a histogram; generating comparative spending reports; adding catagories; and producing hard copy reports. The only limitation is your imagination. To aid in any modifications, variable directories are included in the main programs. This package requires at least one disk drive and a minimum of 16K memory.

UPDATE

```
1 REM ********** VARIABLE DIRECTORY ********************
2 REM * CAT$,AMT$,DAT$,NUM$ -> CATAGORY,AMOUNT,DATE,# ACCESSES*
3 REM * B -> MENU CHOICE ***** X -> AMOUNT OF TRANSACTION     *
4 REM * D$ -> CURRENT TRANSACTION DATE                        *
5 REM * TEM -> TEMPARARY TRANSACTION AMOUNT                   *
6 REM * V -> LOGICAL RECORD NUMBER                           *
7 REM * AT -> TEMPARARY VARIABLE                             *
8 REM ***********************************************
10 CLEAR 1000
30 OPEN "R",1,"EXPEN/DAT"
35 CLS
40 FIELD 1, 14 AS CAT$, 7 AS AMT$, 8 AS DAT$, 2 AS NUM$
50 N=10
54 PRINT TAB(10) "ENTER TODAY'S DATE (MM/DD/YY)" : INPUT D$
55 CLS : PRINT : PRINT : PRINT TAB(10) "EXPENSE CATAGORIES"
60 PRINT TAB(N) "RENT.....................1"
70 PRINT TAB(N) "FOOD.....................2"
80 PRINT TAB(N) "UTILITIES................3"
90 PRINT TAB(N) "GAS......................4"
100 PRINT TAB(N) "CLOTHES.................5"
110 PRINT TAB(N) "ENTERTAINMENT...........6"
120 PRINT TAB(N) "OTHER...................7"
125 PRINT TAB(N) "END PROGRAM.............8"
128 PRINT TAB(N) "END OF MONTH............9"
129 PRINT TAB(N) "MONTHLY REPORTER........10"
130 PRINT : PRINT TAB(N+5) "ENTER DESIRED NUMBER" : INPUT B
140 ON B GOTO 160,200,240,280,320,360,400,440,500,600
150 PRINT "NOT A VALID NUMBER - TRY AGAIN!! " : GOTO 55
155 REM ********** R E N T **********
160 CLS : V=1
165 INPUT "ENTER AMOUNT SPENT ON RENT";X
170 GOSUB 1000
193 PRINT : PRINT : INPUT "IS THIS CORRECT (Y/N)";S$
194 IF S$="N" GOTO 160
195 GOSUB 1999
196 GOTO 55
199 REM ********** F O O D **********
200 CLS : V=2
205 INPUT "ENTER AMOUNT SPENT ON FOOD";X
210 GOSUB 1000
211 PRINT : PRINT : INPUT "IS THE CORRECT (Y/N)";S$
212 IF S$="N" GOTO 200
215 GOSUB 1999
220 GOTO 55
225 REM ********** U T I L I T I E S **********
240 CLS : V=3
245 INPUT "ENTER AMOUNT SPENT ON UTILITIES";X
250 GOSUB 1000
255 PRINT : PRINT : INPUT "IS THIS CORRECT (Y/N)";S$
260 IF S$="N" GOTO 240
265 GOSUB 1999
270 GOTO 55
275 REM ********** G A S **********
280 CLS : V=4
285 INPUT "ENTER AMOUNT SPENT ON GAS";X
290 GOSUB 1000
295 PRINT : PRINT : INPUT "IS THIS CORRECT (Y/N)";S$
300 IF S$="N" GOTO 280
305 GOSUB 1999
310 GOTO 55
315 REM ********** C L O T H E S **********
320 CLS : V=5
325 INPUT "ENTER AMOUNT SPENT ON CLOTHES";X
330 GOSUB 1000
335 PRINT : PRINT : INPUT "IS THIS CORRECT (Y/N)";S$
340 IF S$="N" GOTO 320
345 GOSUB 1999
350 GOTO 55
355 REM ********** E N T E R T A I N M E N T **********
360 CLS : V=6
365 INPUT "ENTER AMOUNT SPENT ON ENTERTAINMENT";X
370 GOSUB 1000
375 PRINT : PRINT : INPUT "IS THIS CORRECT (Y/N)";S$
380 IF S$="N" GOTO 360
385 GOSUB 1999
390 GOTO 55
```

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```
395 REM ************** O T H E R ***************************
400 CLS : V=7
405 INPUT "ENTER AMOUNT SPENT ON OTHER";X
410 GOSUB 1000
415 PRINT : PRINT : INPUT "IS THIS CORRECT (Y/N)";S$
420 IF S$="N" GOTO 400
425 GOSUB 1999
430 GOTO 55
435 REM ************** E   N   D ************************
440 CLOSE
445 STOP
500 RUN "MONTHRE/BAS"
510 GOTO 445
599 REM ********** R E P O R T E R ************************
600 RUN "REPORT/BAS"
610 GOTO 445
1000 GET 1,V
1010 PRINT : PRINT TAB(10) "CATAGORY:"; STRING$(14," "), CAT$
1015 PRINT TAB(10) "AMOUNT SPENT TO DATE:";
STRING$(8," ") ,CVS(AMT$) : PRINT TAB(10)
"DATE LAST ACCESSED:"; STRING$(9," "), DAT$
1020 PRINT TAB(10) "NUMBER OF TIMES ACCESSED:";
STRING$(12," "),CVI(NUM$)
1030 AT=CVS(AMT$) : TEM=AT+X : PRINT : PRINT
"UPDATED AMOUNT IS:",TEM
1035 RETURN
1999 CNT=CVI(NUM$)+1
2000 LSET AMT$=MKS$(TEM)
2010 LSET DAT$=D$
2015 LSET NUM$=MKI$(CNT)
2020 PUT 1,V
2030 RETURN
2035 END
```

MSTEX

```
1 REM MSTEX/BAS
5 CLS
8 PRINT : PRINT "ZEROING OUT OLD DATA"
10 CLEAR 1000
20 OPEN "R",1,"EXPEN/DAT"
30 FIELD 1,14 AS CAT$,7 AS AMT$, 8 AS DAT$, 2 AS NUM$
40 FOR I=1 TO 7
50 READ C$,A,D$,N
60 LSET CAT$=C$
70 LSET AMT$=MKS$(A)
75 LSET DAT$=D$
76 LSET NUM$=MKI$(N)
80 PUT 1,I
90 NEXT I
100 CLOSE
110 PRINT : INPUT "DO YOU WANT TO START UPDATING
THIS MONTH (Y/N)";H$
111 IF H$="N" GOTO 190
115 RUN "UPDATE/BAS"
117 GOTO 190
120 DATA RENT,0.0,00/00/00,0
130 DATA FOOD,0.0,00/00/00,0
140 DATA UTILITIES,0.0,00/00/00,0
150 DATA GAS,0.0,00/00/00,0
160 DATA CLOTHES,0.0,00/00/00,0
170 DATA ENTERTAINMENT,0.0,00/00/00,0
180 DATA OTHER,0.0,00/00/00,0
190 END
```

MONTHRE

```
0 REM "MONTHRE/BAS"
1 REM ************** VARIABLE DIRECTORY ********************
2 REM * E$ -> NEW MONTH NAME **** M$ -> LAST MONTH NAME      *
3 REM * CG$(I), AT$(I) -> CATAGORY (I) AND AMOUNT (I)       *
4 REM * U -> NEXT PHYSICAL RECORD TO STORE                   *
5 REM * V -> CURRENT PHYSICAL RECORD                         *
6 REM * ANT$(V), CA$(V) -> STORED CATAGORY AND AMOUNT (V)    *
7 REM ***********************************************************
10 CLEAR 1000
20 CLS
30 DIM CA$(7), AT(7)
35 INPUT "ENTER THREE LETTERS FOR MONTH";E$
40 OPEN "R",1,"EXPEN/DAT"
45 FIELD 1, 14 AS CAT$, 7 AS AMT$
50 OPEN "R",2,"MONTHTOT/DAT"
55 FIELD 2, 3 AS M$, 14 AS CG$(1), 5 AS AT$(1)
56 FIELD 2, 23 AS DUMMY$, 14 AS CG$(2), 5 AS AT$(2)
57 FIELD 2, 43 AS DUMMY$, 14 AS CG$(3), 5 AS AT$(3)
58 FIELD 2, 63 AS DUM$, 14 AS CG$(4), 5 AS AT$(4)
59 FIELD 2, 83 AS DU$, 14 AS CG$(5), 5 AS AT$(5)
60 FIELD 2, 103 AS D$, 14 AS CG$(6), 5 AS AT$(6)
61 FIELD 2, 123 AS DUMMY$, 14 AS CG$(7), 5 AS AT$(7)
63 U=LOF(2)+1
65 PRINT : PRINT "GETTING MONTH ENDED DATA"
80     FOR V=1 TO 7
90     GET 1,V
100    CA$(V)=CAT$
110    ANT(V)=CVS(AMT$)
120    NEXT V
125 LSET M$=E$
127 PRINT : PRINT "STORING MONTH ENDED DATA"
130 FOR I=1 TO 7
140 LSET CG$(I)=CA$(I)
150 LSET AT$(I)=MKS$(ANT(I))
160 NEXT I
170 PUT 2,U
180 CLOSE
190 CLS
210 PRINT : INPUT "DO YOU WANT MONTH ENDED TOTALS (Y/N)";F$
220 IF F$="N" GOTO 400
221 CLS
225 PRINT TAB(15) "SPENDING REPORT" : PRINT TAB(15)
"FOR MONTH OF ";E$
230 PRINT : PRINT "CATAGORY", "AMOUNT"
235 FOR I=1 TO 7
240 PRINT CA$(I), ANT(I)
245 SUM=SUM+ANT(I)
250 NEXT I
255 PRINT "TOTAL", SUM
300 PRINT : INPUT "HIT <ENTER> WHEN DONE VIEWING";Q
400 CLS : PRINT "CLOSING OUT MONTH ENDED FILE"
410 RUN "MSTEX/BAS"
440 END
```

REPORT

```
0 REM "REPORT/BAS"
1 REM ************** VARIABLE DIRECTORY ********************
2 REM * CG$(I), AT$(I) -> CATAGORY (I) AND AMOUNT (I)       *
3 REM * U -> PHYSICAL RECORD NUMBER                          *
4 REM * RT -> REPORT TOTAL                                  *
```

continued on page 57

PREGNANCY AND THE COMPUTER—HOW TO COPE

Bob Krotts

The woman who promised to love, honor, and turn off the computer after I have fallen asleep at the keyboard is six months pregnant. This period of your life can be extremely trying—especially for the little woman carrying our future programmer!

Let's face if—if one of the two partners in a marriage is not at all interested in computers, there can be problems. These problems can be compounded tremendously if the one not computer-oriented is the female (especially if she is pregnant).

By tradition, the future mother is a grouch. She either gets too much attention or too little. If she can blame your lack of affection on an inanimate object like a computer, her cause is justified.

Suppose she is feeling particularly irritable and unsocial. She just wants to be left alone. Obeying this like a good, meek husband, you look around for something to do and—lo and behold—there is your computer just dying to be taken out for a test drive with that new game you received today in the mail!

You sit down, begin to load the program into the machine, and—before it is loaded—she runs screaming into the room with tears in her eyes saying that you prefer the *computer* to *her!* What can you do? You can't win either way!

I *could* just say that she is right, turn around, and continue playing . . . but I *really* would hate to have a printer broken over my head!

You say you are sorry, give her a few hugs and kisses, and say that it won't happen again. Temporarily satisfied, she walks off—leaving you alone with your computer that you know is just *dying* to have its RAM and ROM stretched to the limit with fancy programs...and the cycle is eventually repeated. The story of my life!

I have found a few solutions:

Pregnant women *love to soak in the bathtub (the water alleviates the pressure on their backs). Walk in, give her a kiss, then quietly sneak back to the computer!*

You can pray for a rerun of Star Trek or *MASH* that your wife has somehow missed over the years. After all, watching television is *close* to the same thing as watching a computer, so theoretically she shouldn't complain at this time!

The most simple solution is to use the computer when she is away or asleep. However, if she wakes up in the middle of the night and you are not right there next to her . . . wow! You *almost* better wish that you were out with another woman—because if she catches you playing at the console she can throw her ultimate line: "You would rather be playing with your computer than be in bed with me!" That is a killer—and there is *nothing* you can say that will pacify her at this point! If you don't want to wake up and find a shoe embedded in the screen, you had *better* go right to bed!

Try to do things together—watch TV, see a movie, play cards. For a change, go out of your way to do things that *she* likes to do! Who knows? She might even feel a little guilty and actually *suggest* that you play with your computer! This also works in reverse: give her too much attention on purpose, and she may try to get rid of you (by suggesting the computer).

Well, in a few months I will be a proud father. Hopefully, the newborn child will keep her too busy to interfere with my computer activity. Only time will tell. I wonder if the hospital will allow me to bring the computer with me to the delivery room . . . ?

Bob Krotts
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COLOR COMPUTER CORNER

continued from page 41

has a lot to offer. Arcade game enthusiasts should welcome this new game to their collection.

I also received a copy of a game called "Scarfman" from the Cornsoft group. Scarfman is another Pacman variant, similar to Ghost Gobbler reviewed in the last issue. Scarfman is a reasonably well put together game, but doesn't compare in quality with Ghost Gobbler in either speed or visual quality. Scarfman uses either the arrow keys or the joystick to move around (which may or may not be a plus, depending on personal preference). Ghost Gobbler doesn't have this option. (Well, not everyone can be the best.)

Some Editorial Comments

The statement "A computer is only as good as the programs that run on it" is, in my opinion, overstated. On the other hand, it is often true. A computer "system" includes both the hardware and software for the computer. I've discussed the merits of the Color Computer hardware over the past year in this column. Frankly, I view the Color Computer as a "system" with a great deal of potential. It certainly doesn't have the versatility of a large $6,000 S-100 system, but it also lacks the 4 to 5 figure price tag. The slow start in software availability didn't help to move the system along. At this point in time, the supply of Color Computer software is increasing daily. Radio Shack has made a big point of the fact that it DOES intend to continue to produce and support the Color Computer. Finally, there is some evidence that the Color Computer disk system is beginning to be accepted. My current goal with this column is to provide a representative sample of Color Computer programs (both by Radio Shack and by independent software companies). Clearly, I can't write about EVERY program ever written. If you have a favorite program, write in and tell me about it. After all, the best resource we personal computer users have is all of the other personal computer users. As you thumb through any issue of Computronics, you should be aware of the fact that the overwhelming percentage of articles and programs are submitted by readers such as yourselves. So, if you have any ideas or programs (between "Spectaculating" your finances, or zapping meteors and enemy death stars), send them in! ■

ASSEMBLY LANGUAGE FOR BEGINNERS (PART 7)

Joseph Rosenman

This month, let's begin with an introduction to several assembler directives. An assembler directive is an instruction to the assembler, to DO something. What makes a directive different from mnemonics, is that THEY DON'T GENERATE MACHINE CODE. Directives tell the Assembler to perform some action, it doesn't cause the machine code to do anything. Examine the following list:

```
Label   Command Argument        Comment
        ORG     Address
        END     label
symbol  EQU     value
symbol  DEFL    value
symbol  DEFB    n               ;n is a 1 byte value
symbol  DEFW    nn              ;nn is a 2 byte value
symbol  DEFM    'text'          ;text is some string
symbol  DEFS    nn              ;nn is the size
```

ORG tells the assembler where (in memory) to put the code that is generated. The "Address" contained in the argument field of the ORG must contain a valid address (or a symbol representing a valid address). The ORG statement can appear more then once in a program. If it does, then everything generated after the new ORG statement will go to the address specified in the new ORG statement. There is no limit to the number of ORG statements in a program. In general practice, only 1 ORG statement is used at the very start of the program.

END tells the assembler that the program is over. Generally, END is the last statement in a program. END has one additional function. Usually, the first executable statement in a program has a LABEL (usually the name of the program). If the END statement has a symbol in its argument field, it tells the assembler that "the address of the symbol is the first location to execute."

EQU tells the assembler that the Symbol in the LABEL field will equal the value in the ARGUMENT field (read EQU as EQUATE). Symbols can be EQUated to both 1 and 2 byte values. A symbol can be EQUated only once, though the EQU can appear anyplace in the program (it is a good practice to place all EQUates at the very begining of your program). Every EQU must have a symbol in the LABEL field, and a value in the ARGUMENT field. Consider the following sequence (the current values are in the comment field):

```
Label   Command Argument        Comment
SYM1    EQU     100H            ;100H
SYM2    EQU     SYM1+10         ;10AH
VAL     EQU     SYM2-SYM1       ;0AH
VAL1    EQU     SYM1            ;100H
VAL2    EQU     VAL1*4          ;400H
```

Now here are some things NOT to do:

```
Label   Command Argument        Comment
VAL     EQU     100H            ;100H
VAL1    EQU     20              ;14H
VAL     EQU     VAL+VAL1        ;ERROR!!!
VAL1    EQU     VAL+7           ;ERROR!!!
VAL2    EQU     5FFFFH          ;ERROR!!!
```

The reason for the first two errors is that the symbols are being re-EQUated. The last error is due to the fact that 5FFFFH exceeds the largest legal value, 0FFFFH (5FFFFH=393215).

DEFL is very similar to the EQU, except that it CAN be redefined. It is just like the EQU in every other regard. Thus:

```
Label   Command Argument        Comment
VAL     DEFL    100H            ;100H
VAL1    DEFL    20              ;14H
VAL     DEFL    VAL+VAL1        ;114H
VAL1    DEFL    VAL+7           ;11BH
VAL2    DEFL    5FFFFH          ;ERROR!!!
```

Of course, the 5FFFFH will still cause an error.

DEFB causes a byte to be generated, which will contain the value that is in the ARGUMENT field. This directive may have a Symbol associated with it, though this is optional. DEFB can appear anyplace in a program. It is important, however, to be sure that values that have been defined won't be executed. It is advisable to place all DEFBs (along with all DEFWs, DEFMs, and DEFSs) outside of any executable code. It is often a good idea to place all the DEFs after the program proper.

DEFW operates just like the DEFB, except that it allocates and stores 2 bytes (a sixteen bit value). Whenever you want to store an address in memory, you must use a DEFW (since all addresses are sixteen bits long).

DEFM will allocate anywhere from 1 byte to 63 bytes. The argument field will contain a STRING (or a text message in quotes). The number of bytes allocated is determined by the size of the message.

DEFS will allocate an area of memory anywhere from 1 byte to FFFFH bytes! This area remains un-initialized (nothing is put into it).

One final addition. There is a special symbol used in assembly language, known as the dollar sign ($). The $ represents "the current address." The use of the $ is one of those confusing things that one finds in assembly language, but is actually very simple.

Now I am sure that you are all pleading for some examples, so:

```
Label   Command Argument        Comment
        ORG     7800H           ;Program starts here.
BUF     EQU     7900H
TEST    EQU     $               ;TEST=7800H
        LD      HL,$            ;HL=7800H
        LD      DE,$            ;DE=7803H
        LD      BC,$+3          ;BC=7809H
TEST2   EQU     $               ;TEST2=7809H
VAL     EQU     $               ;VAL=7809H
VAL1    EQU     TEST2           ;VAL1=7809H
        END     TEST
```

This example will help show how the $ works. The first statement says "The machine code that is being generated will start at address 7800H." For whatever reason, the Symbol BUF is associated with the value 7900H. When the ORG statement occured, the internal $ value was set to the ORG value. Since no code was generated yet, the $ still has the value 7800H when the assembler encountered the TEST EQU $ statement. Remember, the BUF EQU 7900H statement didn't generate any machine code (it just set the value of the symbol BUF). Now the next statement does generate machine code, since it is a machine language mnemonic. This means "Load the current $ value into the HL register." Since nothing had changed the current $, it remained at 7800H. The $ changes value after this statement, since 3 bytes of machine code were generated. (Trust me that it is 3 bytes. When you start assembling your programs, you will be able to see the number of bytes generated for different instructions.) Now, the $ equals 7803H. The "LD DE,$" will load the current value of $ into the DE register, namely 7803H. The $ is then set to 7806H, since 3 more bytes of code were generated. The "LD BC,$+3" will load BC with the value of the $ (7806H) plus 3. Thus, BC=7809H. After this instruction is executed, the $ will equal 7809H (3 more bytes of code were generated). I believe that the rest is straightforward.

Now, on to some DEFs!.

```
Label   Command Argument        Comment
        ORG     7000H
VAL     EQU     10              ;0AH
LOC1    DEFB    10              ;0AH
        DEFB    VAL             ;0AH
LOC2    DEFB    VAL+VAL         ;14H
        DEFB    15H             ;15H
;
        DEFW    0FFFFH          ;0FFFFH
LOCX    DEFW    LOC1            ;7000H
        DEFW    VAL             ;000AH
        DEFW    LOC1+VAL        ;700AH
LOCZ    DEFW    LOCZ            ;700CH
LOCQ    DEFW    $               ;700EH
;
TEXT    DEFM    'This is a text message'
; and it used 22 bytes.
BUF     DEFS    10H             ;save 16 bytes
        DEFS    VAL             ;save 0AH bytes
        END
```

What's more, here is what memory looks like after this program is "loaded in.":

```
7000  0A 0A 14 15 FF FF 00 70 0A 00 0A 70 0C 70 0E 70
7010  54 68 69 73 20 69 73 20 61 20 74 65 78 74 20 6D
7020  65 73 73 61 67 65 00 01 02 03 04 05 06 07 08 09
7030  0A 0B 0C 0D 0E 0F 10 11 12 13 14 15 16 17 18 19
```

(Note that starting at address 7026H I began a series of increasing numbers. These values were "there before" and are located in the area reserved by the DEFS directives.)

The values in 7000H to 700FH were set by the DEFB and DEFW directives. The DEFM text was saved in addresses 7010H to 7205H. So WHAT ARE NUMBERS DOING THERE? Remember, computers only remember numbers! The answer is ASCII.

ASCII is an acronym for American Standard Code for Information Interchange. ASCII is a special code (7 bits long), that is usually used to represent text (or character) information. The way ASCII works is by assigning every character a unique number. At the end of this article, I have reproduced a chart of ASCII values. Examine the memory between 7010H and 7205H, and compare it with the chart. You will see that the message was converted into ASCII, and saved in memory (1 byte per character). Note that I said that ASCII is 7 bit. The eigth bit is usually set to 0. (The TRS-80 uses this bit to indicate graphic codes, special characters, and/or space compression codes. This is a special application on the TRS-80, and is not part of standard ASCII.)

We are about ready to start writing programs that actually DO something. In the next issue, we will begin by looking at the TRS-80 Video display, and things that can be done on it.

Joseph Rosenman
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Flushing, NY 11358 ■

ASCII Codes table on page 56

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ASCII Codes

ØØH	NUL	2ØH	SP	4ØH	@	6ØH	left quote
Ø1H	SOH	21H	!	41H	A	61H	a
Ø2H	STX	22H	"	42H	B	62H	b
Ø3H	ETX	23H	#	43H	C	63H	c
Ø4H	EOT	24H	$	44H	D	64H	d
Ø5H	ENQ	25H	%	45H	E	65H	e
Ø6H	ACK	26H	&	46H	F	66H	f
Ø7H	BEL	27H	'	47H	G	67H	g
Ø8H	BS	28H	(	48H	H	68H	h
Ø9H	HT	29H	)	49H	I	69H	i
ØAH	LF	2AH	*	4AH	J	6AH	j
ØBH	VT	2BH	+	4BH	K	6BH	k
ØCH	FF	2CH	,	4CH	L	6CH	l
ØDH	CR	2DH	-	4DH	M	6DH	m
ØEH	SO	2EH	.	4EH	N	6EH	n
ØFH	SI	2FH	/	4FH	O	6FH	o
1ØH	DLE	3ØH	Ø	5ØH	P	7ØH	p
11H	DC1	31H	1	51H	Q	71H	q
12H	DC2	32H	2	52H	R	72H	r
13H	DC3	33H	3	53H	S	73H	s
14H	DC4	34H	4	54H	T	74H	t
15H	NAK	35H	5	55H	U	75H	u
16H	SYN	36H	6	56H	V	76H	v
17H	ETB	37H	7	57H	W	77H	w
18H	CAN	38H	8	58H	X	78H	x
19H	EM	39H	9	59H	Y	79H	y
1AH	SUB	3AH	:	5AH	Z	7AH	z
1BH	ESC	3BH	;	5BH	left brace	7BH	left brace
1CH	FS	3CH	<	5CH	back slash	7CH	vertical bar
1DH	GS	3DH	=	5DH	right brace	7DH	right brace
1EH	RS	3EH	>	5EH	caret	7EH	tilde
1FH	US	3FH	?	5FH	underline	7FH	DEL

NUL = Null
STX = Start of Text
EOT = End of transmission
ACK = Acknowledge
BS = Back space
LF = Line feed
FF = Form feed
SO = Shift out
DLE = Data Link Escape

DC2 = Device code 2
DC4 = Device code 4
SYN = Synchronize
CAN = Cancel
SUB = Substitue
FS = File separator
RS = Record separator
SP = Space

SOH = Start of Header
ETX = End of Text
ENQ = Enquiry
BEL = Bell
HT = Horizontal tab
VT = Vertical tab
CR = Carriage return
SI = Shift in
DC1 = Device code 1

DC3 = Device code 3
NAK = Not acknowledge
ETB = End of transmission block
EM = End of Medium
ESC = Escape
GS = Group separator
US = Unit Separator
DEL = Delete

RECORDS AND FILES

continued from page 49

```
200 DATA 295,MEMPHIS,12 05 PM
210 DATA 382,DENVER,1 05 PM
220 DATA 444,CHICAGO,2 25 PM
230 DATA 488,DALLAS,3 45 PM
240 DATA 499,SEATTLE,5 u5 PM
250 DATA 500,LOS ANGELES,7 30 PM
260 DATA 0,DUMMY,DATA
270 '
280 READ R,C$,T$              'RECORD NUMBER,CITY,TIME
290 IF R=0 THEN 350           'FINISHED READING DATA
300 GOSUB 570                 'OPEN AND MEASURE FILE
310 GOSUB 660                 'WRITE RECORD # R
320 GOSUB 690                 'WRITE LAST SECTOR
330 GOTO 280                  'READ ANOTHER RECORD
340 '          LOOK UP FLIGHTS
350 CLS                       'CLEAR THE SCREEN
360 INPUT "FLIGHT NUMBER";R
370 IF R<1 OR R>500 THEN 360  'OUT OF RANGE
380 GOSUB 570                 'OPEN AND MEASURE THE FILE
390 GOSUB 620                 'GET RECORD # R
400 CLOSE 1
410 IF C$ < "A" THEN 440      'VACANT SUBSECTOR IN FILE
420 PRINT C$;T$               'DISPLAY THE RECORD
430 GOTO 450                  'SKIP THE ERROR MESSAGE
440 PRINT "NO FLIGHT BY THAT NUMBER"
450 PRINT
460 GOTO 360                  'CYCLE
470 '=========================================================
```

continued on next page

SCRAMBLE

Frank S. Kasper

Have you ever played any ofthe many word games that utilize jumbled letters to spell real words? Here is a short program that can scramble or unscramble these words. In some cases one set of scrambled letters will spell many real words.

SCRAMBLE will assemble all permutations of any given word up to a maximum of seven letters. Each letter is treated as a separate letter even if the letter is repeated. The number of letters in the word will determine the number of permutations in accordance with the following formula:

$$P(n,r) = n \times (n-1) \times \ldots \times (n-r+1)$$

The speed at which the scrambling is done is determined by the number of letters in the given word and whether or not a line printer is used. The following table shows the number of permutations and the running times for different word lengths:

No. of letters in the word	No. of permutations	Approximate time to complete
3	6	9 seconds
4	24	74 seconds
5	120	600 seconds
6	720	75 minutes
7	5040	?

```
900 ' SCRAMBLE WRITTEN BY FRANK S. KASPER, NOV. 1980
990 CLEAR 1000: CLS
1000 INPUT "WORD TO BE SCRAMBLED";A$
1005 INPUT "IS A PAPER COPY DESIRED (YES,NO)";Q$
1010 W=LEN(A$)
1020 FOR S=0 TO (W-1): A$(S)=LEFT$(A$,1):
A$=RIGHT$(A$,(LEN(A$)-1)): NEXT S
1030 FOR Z=0 TO W-1: N$=STR$(Z): N1$=N1$+N$: M1$=N$+M1$:
NEXT Z: NN=VAL(N1$): M=VAL(M1$)
1035 PRINT @ 192, "THE COUNTING NUMBER IS",
1037 PRINT @ 320, "THE SCRAMBLED WORD IS",
1040 FOR N=NN TO M
1050 PRINT @ 222, "                    ",: PRINT @ 222,N
1060 N$=STR$(N)
1070 NN$=N$: FOR Z=W-1 TO 0 STEP -1: N$(Z)=RIGHT$(NN$,1):
NN$=LEFT$(NN$,(LEN(NN$)-1)): NEXT Z
1080 FOR Z=0 TO W-1: N(Z)=VAL(N$(Z)): NEXT Z
1097 FOR S=0 TO W-2: IF N(W-1)=N(S) THEN NEXT N
1098 NEXT S
1100 FOR S=0 TO W-2
1105 FOR T=S+1 TO W-2
1110 IF N(S)=N(T) THEN IF S<>T THEN N(T)=N(T)+1: GOTO 1500
1120 NEXT T
1125 NEXT S
1130 FOR Z=0 TO W-1: IF N(Z)>W-1 THEN N(Z)=0:
N(Z-1)=N(Z-1)+1: GOTO 1500
1135 NEXT Z
1150 FOR Z=0 TO W-1: B$=B$+A$(N(Z)): NEXT Z
1155 PRINT @ 351,"              ";
1160 PRINT @ 351,B$
1170 IF LEFT$(Q$,1)="Y" THEN LPRINT B$
1175 B$=""
1180 NEXT N
1190 END
1500 N=0: FOR Z=0 TO W-1: N=N+N(Z)*10↑(W-1-Z): NEXT Z
1510 GOTO 1050
```

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continued from previous page

```
480 '         SUBROUTINES TO HANDLE RANDOM FILE
490 '   (9 RECORDS PER SECTOR = 28 BYTES PER RECORD)
500 '   K%      RECORDS TO BE SKIPPED IN CURRENT SECTOR
510 '   LOF(1)  NUMBER OF SECTORS IN THE FILE
520 '   N       NUMBER OF RECORDS IN THE FILE
530 '   R       CURRENT RECORD NUMBER
540 '   S       CURRENT SECTOR NUMBER
550 '   Z, Z$   NUMBER OF RECORDS IN THE LAST SECTOR
560 '
570 OPEN "R",1,"FLIGHTS/RAN"   'OPEN SUBROUTINE
580 IF LOF(1)=0 THEN N=0  :RETURN
590 FIELD 1,255 AS XS$,1 AS Z$
600 GET 1,LOF(1)
610 Z=VAL(Z$)  :N=9*(LOF(1)-1)+Z  :RETURN
620 S=INT((R+8)/9)             'GET SUBROUTINE
630 K%=R-9*(S-1)-1
640 FIELD 1,28*K% AS XS$,20 AS C$,8 AS T$
650 GET 1,S  :RETURN
660 GOSUB 620                  'PUT SUBROUTINE
670 LSET C$=C$  :LSET T$=T$
680 PUT1,S  :RETURN
690 IF N < R THEN N=R          'CLOSE SUBROUTINE
700 Z=N-9*(INT(N/9))  :IF Z=0 THEN Z=9
710 FIELD 1,255 AS XS$,1 AS Z$
720 GET 1,LOF(1)  :LSET Z$=CHR$(48+Z)
730 PUT 1,LOF(1)  :CLOSE 1  :RETURN
```

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MONTHLY EXPENDITURE INFORMATION PACKAGE

continued from page 52

```
5 REM * W -> NUMBER OF MONTHS REPORTED                          *
6 REM * T -> CATAGORY COUNTER                                   *
7 REM ***********************************************************
10 CLS
20 CLEAR 1000
30 INPUT "HOW MANY MONTHS DO YOU WANT REPORTED";W
40 OPEN "R",1,"MONTHTOT/DAT"
50 FIELD 1, 3 AS M$, 14 AS CG$(1), 5 AS AT$(1)
60 FIELD 1, 23 AS DUMMY$, 14 AS CG$(2), 5 AS AT$(2)
70 FIELD 1, 43 AS DUMMY$, 14 AS CG$(3), 5 AS AT$(3)
80 FIELD 1, 63 AS DUMMY$, 14 AS CG$(4), 5 AS AT$(4)
```

continued on next page

Z80 REFERENCE GUIDE

Joseph Rosenman

This table is a very useful reference guide for using the Z80 instructions. As long as you are able to read the Z80 mnemonics, you will be able to see at a glance all of the valid uses of the instructions, the instruction timing, number of bytes required, flag settings, and Intel 8080 compatibility. The timings presented are for the Model 3 TRS-80 (or a standard Z80 2 megahertz clock). Since the model 1 runs at 1.77 MHz, the instruction timing is somewhat slower. There is a Model 3 to Model 1 conversion table presented at the end of the table.

Z80 INSTRUCTION REFERENCE TABLE

(for a standard Z80 2 MHz clock)

r = single register (A, B, C, D, E, H, L)
n = 1 byte constant
nn = 16 bit constant
d = 1 byte displacement (-128 to +127)
p = jump vector for RST (a multiple of 8 between 0 and 56).
ss = double register (AF, BC, DE, HL)
pp = double register (BC, DE, SP, IR where both IRs are equal)
b = bit position (0-7)
cc = Condition codes:

Flag	On Code	Off Code
Zero	Z	NZ
Carry	C	NC
Sign	C	NC
Sign	M (minus)	P (plus)
Parity	PE (even)	PO (odd)

Flag Register: 7 6 5 4 3 2 1 0
S Z - H - p n c

Possible Instruction Flag Codes:
= No Change
S = Flag Set
C = Flag Cleared
B = Flag Set or Cleared depending on instruction result
U = Effect unknown
X = Special use

8 Bit Load Instructions

SYM	ARG	BYTES	T-STATES	Mcs	8080	FLAGS S	Z	H	N	PV	C
LD	r,r	1	4	2.00	*	.	.	.	.	.	.
LD	r,n	2	7	3.50	*	.	.	.	.	.	.
LD	r,(HL)	1	7	3.50	*	.	.	.	.	.	.
LD	r,(IR+d)	3	19	9.50		.	.	.	.	.	.
LD	A,(BC)	1	7	3.50	*	.	.	.	.	.	.
LD	A,(DE)	1	7	3.50	*	.	.	.	.	.	.
LD	A,(nn)	3	13	6.50	*	.	.	.	.	.	.
LD	(HL),r	1	7	3.50	*	.	.	.	.	.	.
LD	(HL),n	2	10	5.00	*	.	.	.	.	.	.
LD	(IR+d),r	3	19	9.50		.	.	.	.	.	.
LD	(BC),A	1	7	3.50	*	.	.	.	.	.	.
LD	(DE),A	1	7	3.50	*	.	.	.	.	.	.
LD	A,I	2	9	4.50		B	B	C	C	X	.
LD	I,A	2	9	4.50		.	.	.	.	.	.
LD	A,R	2	9	4.50		B	B	C	C	X	.
LD	R,A	2	9	4.50		.	.	.	.	.	.

16 Bit Load Instructions

SYM	ARG	BYTES	T-STATES	Mcs	8080	FLAGS S	Z	H	N	PV	C
LD	IR,(nn)	4	20	10.00		.	.	.	.	.	.
LD	SP,HL	1	6	3.00	*	.	.	.	.	.	.
LD	SP,IR	2	10	5.00		.	.	.	.	.	.
LD	(nn),qq	4	20	10.00		.	.	.	.	.	.
LD	(nn),HL	3	16	8.00	*	.	.	.	.	.	.
LD	(nn),IR	4	20	10.00		.	.	.	.	.	.
PUSH	qq	1	11	5.50	*	.	.	.	.	.	.
PUSH	IR	2	15	7.50		.	.	.	.	.	.
POP	qq	1	10	5.00	*	.	.	.	.	.	.
POP	IR	2	14	7.00		.	.	.	.	.	.

MONTHLY EXPENDITURE INFORMATION

continued from page 57

```
90 FIELD 1, 83 AS DUMMY$, 14 AS CG$(5), 5 AS AT$(5)
100 FIELD 1, 103 AS DUMMY$, 14 AS CG$(6), 5 AS AT$(6)
110 FIELD 1, 123 AS DUMMY$, 14 AS CG$(7), 5 AS AT$(7)
112 CLS
120 FOR U=1 TO W
121 RT=0
130 GET 1,U
132 FOR T=1 TO 7
133 RT=CVS(AT$(T))+RT
135 NEXT T
140 H$=STRING$(60,"*")
150 PRINT H$
160 PRINT TAB(25) "SPENDING REPORT" : PRINT TAB(25)
"FOR MONTH OF "; M$
165 PRINT "CATAGORY", "AMOUNT", "PERCENTAGE"
170 FOR A=1 TO 7
175 AY=CVS(AT$(A))
176 IF RT=0 GOTO 245
180 PRINT CG$(A), AY, INT(AY/RT*100)
200 NEXT A
205 PRINT
210 PRINT "TOTAL", RT, "100"
220 PRINT : INPUT "HIT <ENTER> TO CONTINUE";O
225 CLS
230 NEXT U
240 CLOSE
245 CLS : PRINT @ 410, "REPORT ENDED"
250 PRINT : PRINT : INPUT "DO YOU WANT TO
START UPDATING (Y/N)";J$
255 IF J$="N" GOTO 265
260 RUN "UPDATE/BAS"
263 GOTO 265
265 END
```

Bill O'Neill
7797 La Riviera Dr.
Sacramento, CA 95682 ■

Exchange, Block Move and Compare

SYM	ARG	BYTES	T-STATES	Mcs	8080	FLAGS S	Z	H	N	PV	C
EX	DE,HL	1	4	2.00	*	.	.	.	.	.	.
EX	AF,AF'	1	4	2.00		.	.	.	.	.	.
EXX		1	4	2.00		.	.	.	.	.	.
EX	(SP),HL	1	19	9.50	*	.	.	.	.	.	.
EX	(SP),IR	2	23	11.50		.	.	.	.	.	.
LDI		2	16	8.00		.	.	C	C	B	.
LDIR		2	21/16	10.50/8.00		.	.	C	C	C	.
LDD		2	16	8.00		.	.	C	C	B	.
LDDR		2	21/16	10.50/8.00		.	.	C	C	C	.
CPI		2	16	8.00		B	B	B	S	B	.
CPIR		2	21/16	10.50/8.00		B	B	B	S	B	.
CPD		2	16	8.00		B	B	B	S	B	.
CPDR		2	21/16	10.50/8.00		B	B	B	S	B	.

8 Bit Arithmetic Instructions

SYM	ARG	BYTES	T-STATES	Mcs	8080	FLAGS S	Z	H	N	PV	C
ADD	A,r	1	4	2.00	*	B	B	B	C	B	B
ADD	A,n	2	7	3.50	*	B	B	B	C	B	B
ADD	A,(HL)	1	7	3.50	*	B	B	B	C	B	B
ADD	A,(IR+d)	3	19	9.50		B	B	B	C	B	B
ADC	A,r	1	4	2.00	*	B	B	B	C	B	B
ADC	A,n	2	7	3.50	*	B	B	B	C	B	B
ADC	A,(HL)	1	7	3.50	*	B	B	B	C	B	B
ADC	A,(IR+d)	3	19	9.50		B	B	B	C	B	B
SUB	r	1	4	2.00	*	B	B	B	S	B	B
SUB	n	2	7	3.50	*	B	B	B	S	B	B
SUB	(HL)	1	7	3.50	*	B	B	B	S	B	B
SUB	(IR+d)	3	19	9.50		B	B	B	S	B	B
SBC	A,r	1	4	2.00	*	B	B	B	S	B	B
SBC	A,n	2	7	3.50	*	B	B	B	S	B	B
SBC	A,(HL)	1	7	3.50	*	B	B	B	S	B	B
SBC	A,(IR+d)	3	19	9.50		B	B	B	S	B	B
INC	r	1	4	2.00	*	B	B	B	C	B	.
INC	(HL)	1	11	5.50	*	B	B	B	C	B	.
INC	(IR+d)	3	23	11.50		B	B	B	C	B	.
DEC	r	1	4	2.00	*	B	B	B	S	B	.
DEC	(HL)	1	11	5.50	*	B	B	B	S	B	.
DEC	(IR+d)	3	23	11.50		B	B	B	S	B	.

16 Bit Arithmetic Instructions

SYM	ARG	BYTES	T-STATES	Mcs	8080	FLAGS S	Z	H	N	PV	C
ADD	HL,ss	1	11	5.50	*	.	.	B	C	.	B
ADC	HL,ss	2	15	7.50		B	B	B	C	B	B
ADD	IR,pp	2	15	7.50		.	.	B	C	.	B
SBC	HL,ss	2	15	7.50		B	B	B	S	B	B
INC	ss	1	6	3.00	*	.	.	.	.	.	.
INC	IR	2	10	5.00		.	.	.	.	.	.
DEC	ss	1	6	3.00	*	.	.	.	.	.	.
DEC	IR	2	10	5.00		.	.	.	.	.	.

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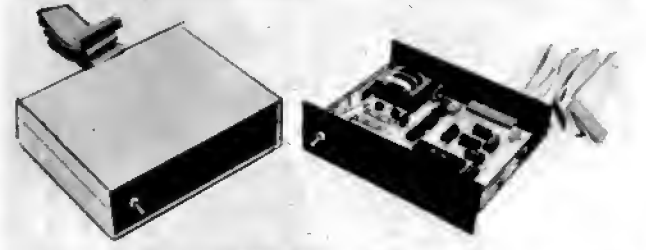

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SYM	ARG	BYTES	T-STATES	Mcs	8080	F L A G S S	Z	H	N	PV	C
AND	r	1	4	2.00	*	B	B	S	C	B	C
AND	n	2	7	3.50	*	B	B	S	C	B	C
AND	(HL)	1	7	3.50	*	B	B	S	C	B	C
AND	(IR+d)	3	19	9.50		B	B	S	C	B	C
OR	r	1	4	2.00	*	B	B	C	C	B	C
OR	n	2	7	3.50	*	B	B	C	C	B	C
OR	(HL)	1	7	3.50	*	B	B	C	C	B	C
OR	(IR+d)	3	19	9.50		B	B	C	C	B	C
XOR	r	1	4	2.00	*	B	B	C	C	B	C
XOR	n	2	7	3.50	*	B	B	C	C	B	C
XOR	(HL)	1	7	3.50	*	B	B	C	C	B	C
XOR	(IR+d)	3	19	9.50		B	B	C	C	B	C
CP	r	1	4	2.00	*	B	B	B	S	B	B
CP	n	2	7	3.50	*	B	B	B	S	B	B
CP	(HL)	1	7	3.50	*	B	B	B	S	B	B
CP	(IR+d)	3	19	9.50		B	B	B	S	B	B
CPL		1	4	2.00	*	.	.	S	S	.	.
NEG		2	8	4.00		B	B	B	S	B	B

Rotate and Shift Instructions

SYM	ARG	BYTES	T-STATES	Mcs	8080	F L A G S S	Z	H	N	PV	C
RLCA		1	4	2.00	*	.	.	C	C	.	X
RLA		1	4	2.00	*	.	.	C	C	.	X
RRCA		1	4	2.00	*	.	.	C	C	.	X
RRA		1	4	2.00	*	.	.	C	C	.	X
RLC	r	2	8	4.00		B	B	C	C	B	X
RLC	(HL)	2	15	7.50		B	B	C	C	B	X
RLC	(IR+d)	4	23	11.50		B	B	C	C	B	X
RRC	r	2	8	4.00		B	B	C	C	B	X
RRC	(HL)	2	15	7.50		B	B	C	C	B	X
RRC	(IR+d)	4	23	11.50		B	B	C	C	B	X
RL	r	2	8	4.00		B	B	C	C	B	X
RL	(HL)	2	15	7.50		B	B	C	C	B	X
RL	(IR+d)	4	23	11.50		B	B	C	C	B	X
RR	r	2	8	4.00		B	B	C	C	B	X
RR	(HL)	2	15	7.50		B	B	C	C	B	X
RR	(IR+d)	4	23	11.50		B	B	C	C	B	X
SLA	r	2	8	4.00		B	B	C	C	B	X
SLA	(HL)	2	15	7.50		B	B	C	C	B	X
SLA	(IR+d)	4	23	11.50		B	B	C	C	B	X
SRA	r	2	8	4.00		B	B	C	C	B	X
SRA	(HL)	2	15	7.50		B	B	C	C	B	X
SRA	(IR+d)	4	23	11.50		B	B	C	C	B	X
SRL	r	2	8	4.00		C	B	C	C	B	X
SRL	(HL)	2	15	7.50		C	B	C	C	B	X
SRL	(IR+d)	4	23	11.50		C	B	C	C	B	X
RLD		2	18	9.00		B	B	C	C	B	.
RRD		2	18	9.00		B	B	C	C	B	.

Bit Set and Reset Instructions

SYM	ARG	BYTES	T-STATES	Mcs	8080	F L A G S S	Z	H	N	PV	C
CCF		1	4	2.00	*	.	.	X	C	.	B
SCF		1	4	2.00	*	.	.	C	C	.	S
BIT	b,r	2	8	4.00		U	B	S	C	U	.
BIT	b,(HL)	2	12	6.00		U	B	S	C	U	.
BIT	b,(IR+d)	4	20	10.00		.	B	S	C	.	.
SET	b,r	2	8	4.00		.	.	.	.	.	.
SET	b,(HL)	2	15	7.50		.	.	.	.	.	.
SET	b,(IR+d)	4	23	11.50		.	.	.	.	.	.
RES	b,r	2	8	4.00		.	.	.	.	.	.
RES	b,(HL)	2	15	7.50		.	.	.	.	.	.
RES	b,(IR+d)	4	23	11.50		.	.	.	.	.	.

Call and Return Instructions

SYM	ARG	BYTES	T-STATES	Mcs	8080	F L A G S S	Z	H	N	PV	C
CALL	nn	3	17	8.50	*	.	.	.	.	.	.
CALL	cc,nn	3	17/10	4.25/2.50	*	.	.	.	.	.	.
RET		1	10	5.00	*	.	.	.	.	.	.
RET	cc	1	11/5	2.75/1.25	*	.	.	.	.	.	.
RETI		2	14	7.00		.	.	.	.	.	.
RETN		2	14	7.00		.	.	.	.	.	.
RST	p	1	11	5.50	*	.	.	.	.	.	.

Jump Instructions

SYM	ARG	BYTES	T-STATES	Mcs	8080	F L A G S S	Z	H	N	PV	C
JP	nn	3	10	5.00	*	.	.	.	.	.	.
JP	cc,nn	3	12	6.00	*	.	.	.	.	.	.
JP	(HL)	1	4	2.00	*	.	.	.	.	.	.
JP	(IR)	2	8	4.00		.	.	.	.	.	.
JR	d	2	12	6.00		.	.	.	.	.	.
JR	cc,d	2	12/7	3.00/1.75		.	.	.	.	.	.
DJNZ	d	2	13/8	3.25/2.00		.	.	.	.	.	.

Input/Output Instructions

SYM	ARG	BYTES	T-STATES	Mcs	8080	F L A G S S	Z	H	N	PV	C
IN	A,(n)	2	11	5.50	*	.	.	.	.	.	.
IN	r,(C)	2	12	6.00		B	B	C	C	B	.
INI		2	16	8.00		U	B	U	S	U	.
INIR		2	21/16	10.50/8.00		U	S	U	S	U	.
IND		2	16	8.00		U	B	U	S	U	.
INDR		2	21/16	10.50/8.00		U	S	U	S	U	.
OUT	(n),A	2	11	5.50	*	.	.	.	.	.	.
OUT	(C),r	2	12	6.00		.	.	.	.	.	.
OUTI		2	16	8.00		U	B	U	S	U	.
OTIR		2	21/16	10.50/8.00		U	S	U	S	U	.
OUTD		2	16	8.00		U	B	U	S	U	.
OTDR		2	21/16	10.50/8.00		U	S	U	S	U	.

Miscellaneous Instructions

SYM	ARG	BYTES	T-STATES	Mcs	8080	F L A G S S	Z	H	N	PV	C
DAA		1	4	2.00	*	B	B	X	.	B	X
NOP		1	4	2.00	*	.	.	.	.	.	.
HALT		1	4	2.00	*	.	.	.	.	.	.
DI		1	4	2.00	*	.	.	.	.	.	.
EI		1	4	2.00	*	.	.	.	.	.	.
IM	0	2	8	4.00		.	.	.	.	.	.
IM	1	2	8	4.00		.	.	.	.	.	.
IM	2	2	8	4.00		.	.	.	.	.	.

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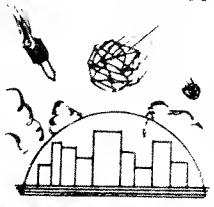

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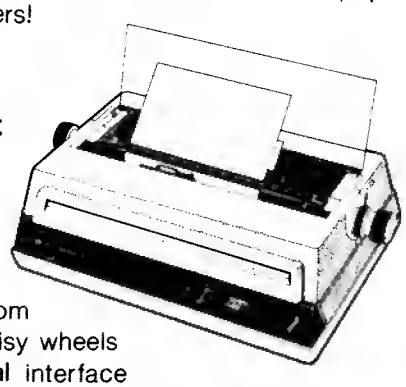

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The General Ledger accounting system consolidates financial data from other accounting subsystems in an accurate and timely manner. Major reports include Trial Balance, Income Statement, Balance Sheet, a user-defined report, and more. All data is maintained and reported by month, quarter, year and previous three quarters. Transactions may be entered via direct posting and external posting generated by A/R, A/P, Payroll - or any other user source.

Accounts Receivable

The objective of a computerized A/R system is to prepare accurate and timely monthly statements to credit customers. Management can generate information required to control the amount of credit extended and the collection of money owed in order to maximize profitable credit sales while minimizing losses from bad debts. This system is invoice-oriented. Invoices can be entered before they're ready for billing, after billing, or even after they are paid. Accounts Receivable allows entry of new invoices, credit memos, debit memos, or modification or deletion invoice and allows for progress payment. The transaction information includes: type of A/R transaction, P.O. #, description of P.O., billing date, general ledger sales account #, invoice amount, shipping and transportation charges, tax charges, payment, and progress payment information. Reports include: summary or detail listing of invoices not yet billed, open items (unpaid invoices), closed items (paid invoices), and aging. Statements may be printed at any time and follow the format of nationally available forms.

Order Entry

The Order Entry Module was designed as a supplement to the Accounts Receivable Module, and will not operate independently. This system allows you to add, change, delete, list and print invoices; apply an invoice to correct customer account; generate computer assigned invoice numbers; note type (invoice credit memo, debit memo); record customer order number, invoice date, shipping date, FOB location, method of shipping, salesman, and payment terms; print selected number of shipping labels; enter, display and correct 10 lines of data per invoice, noting the part number, description, price, quantity ordered, extension, taxable or not. It also allows the user to enter, display and correct invoice totals, noting the invoice subtotal, taxes, shipping and handling, with disbursement up to 5 General Ledger accounts; print a transaction report; maintain a terms code file in the system; update Account Receivable and generate summary report totals. It automatically coordinates to the Inventory Module (if used) to determine description, price and out of stock status, and to immediately deplete inventory stock. Price fields are easily modified to include percent or dollar discount.

Payroll

Payroll involves many complex calculations and the production of reports and documents, many of which are required by government agencies. The Payroll system performs all necessary payroll tasks including file maintenance, pay data entry and verification, computation of pay and deduction amounts, and the printing of reports and checks. State and Federal Tax changes are easily implemented by the user via menu prompting. In its link to General Ledger, each employee's payroll information is distributed to as many as 12 different GL accounts; system automatically posts to cash account.

Accounts Payable

The Accounts Payable system receives data concerning purchases from suppliers and produces checks in payment of outstanding invoices. Several reports are available to supply information needed for the analysis of payments, expenses, purchases and cash requirements. The Accounts Payable system is invoice-oriented. It handles new invoices, credit memos and even debit memos and allows modification and deletion of invoices. The flexible check calculation procedures allows checks to be calculated for a set of vendors, specific vendors or even specific invoices. The reports include open item listings and closed item listings (both detail and summary), debit and credit memo listings, aging, check register report (to give an audit trail of checks printed), and vendor listing and vendor activity. Update reports are useful for audit trails and checking for accuracy. Checks may be printed at any time and follow the format of nationally available forms.

Inventory

Status reports and minimum reorder reports help to reduce the potential hazard of overstocking which results in cash flow problems. Program selection allows the user to store data for inventory located at up to five separate sites (divisions), coding up to 9 sales people. Available reports include inventory master list, price listings, period and year-to-date sales, stock status, minimum reorder point and commission information.

Model I, 48K and 2 Disk Drives . . . $195.00 Per Module
Model III, 48K . . . . . $195.00 Per Module
Model II, 64K . . . . . $295.00 Per Module
Sample Report Printouts . . . . . $ 10.00

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COMMUNICATIONS SYSTEMS

Small Business Systems Group markets a complete line of software which interfaces the TRS-80™ with ANY computer that communicates in ASCII. This family of products offers both terminal and host capabilities to users with even the most minimal hardware configurations. There has been wide interest in these products from "comm buffs," the educational community, and **businesses and individuals who need to communicate on a regular basis.** Our systems are among the most versatile and comprehensive on the market today for TRS-80™ microcomputers.

SMALL BUSINESS SYSTEMS GROUP

ST80-III™ -- The Ultimate Communications System

The "state of the art" in communications processors, designed for complex commercial applications. Included in this package is a set of programs that allow your TRS-80™ to talk to a timesharing computer, transfer files to and from your central business computer, and customize your ST80-III to your specific application.

Features include: Selectable RS232 Setting • Help Display • Echo Feedback • Job Log (LDOS Mod I, Mod III) • 2-User Translation Tables • Auto Logon • 10 Function Keys (Definable) • RUBOUT Key (Definable) • Warm Restart • Automatic I.D. • True Break • Direct Cursor Addressing • DOS Command Support • Transmit Line Feed • Printer Support • Video Display Modes: SCROLL, FORMAT, PAGE, REVERSE VIDEO (Mod II), CURSOR ON/OFF • Auto-answer • Autodial (certain modems) • Append to memory buffer • Big buffer for printer • Off hook / on hook • 10 predefined ASCII strings in translation tables, • Registered users include NASA, USN, UPS, Westinghouse, and many colleges, universities and major banks.

Minimum Requirements: One disk drive, RS232-C, 32K Model I or III, 64K Model II.

Model I or III **$150.00**
Model II **$250.00**

FORUM-80™ -- Communications Network

With Bill Abney's hot new communications product, you and your TRS-80™ can become part of one of the fastest growing communications networks in the country; your computer becomes an on-line bulletin board system: users can leave messages, get messages, swap information; exchange VisiCalc™ reports, charts, graphs or other correspondence with other computers.

Features Include: Security System • Constantly displayed time-in-use figure • User Friendly • User Configurable or can be modified for custom application • Future updates and upgrades available to register owners • Multiple command strings • Non-technical user and operator manuals.

Minimum Requirements: TRS-80™ (3-drive Mod I, 2-drive Mod III), 48K, RS232-C, Auto-answer modem.

Model I or III **$350.00**

ST-80-PBB™ -- Personal Bulletin Board

A small yet powerful bulletin board for the individual to gather and leave electronic mail. Messages reside in data base in memory, eliminating the problem of scanning magnetic media.

Features Include: Password Security System • Four levels of Access--Guest, Member, Owner, Operator • User Log • Four message types • Smart reverse scan to view messages from most recent to oldest.

Minimum Requirements: TRS-80™ (Mod I or III), 16K, Level II, Auto-answer modem, ST80-X10 Host Program ($50), RS232-C.

Model I or III **$50.00**

ST-80-CC™ -- Communications Center

More than a personal bulletin board, this is a complete communications system for low to moderate traffic. Like ST80-PBB™ it supports four levels of users and four levels of messages with text editing and reverse scan of messages.

Additional Features Include: Transmit same message to many individuals • Auto logon and multiple command scanning • Print messages on line printer, save messages in memory buffer, maintain database without user intervention.

Minimum Requirements: TRS-80™ (Mod I or III), Level II, 48K, one disk, Auto-answer modem, ST80-X10 Host Program ($50), RS232-C.

Model I or III **$100.00**

MouseNet™ -- Advanced Bulletin Board System

Designed to accommodate high volume traffic, to operate simply enough for novice users, yet is fast and powerful enough for experienced callers.

Features Include: Messages stored on disk in keyed file • Uses machine language subroutines for speed • Supports text editing commands • Help commands guide user • System bulletins display each time a user logs on • All messages are dated.

Minimum Requirements: TRS-80™ (Mod I or III), 48K, RS232-C, 3 Disks, Auto-answer modem, text editor (such as Scripsit).

Model I or III **$295.00**

DELUXE PERSONAL FINANCE For TRS-80™ Model II

This is a sophisticated and unique financial analysis package which can be readily customized to suit your personal financial situation. It will:

- Accept and apply transactions to user-formatted budget categories.
- Separate cash and check disbursements.
- Allows up to ten category disbursements per check.
- Credit income/deposits according to source.
- Search, correct or void checks.
- Maintain an accurate checking account balance.
- Cancel returned checks.
- Provide monthly summaries of income vs. expenses.
- Calculate profit/loss.
- Summarize data by categories.
- Provides up to ten savings account summaries.

Model II **$75.00**
Model I Version **$35.00**

ACCESSIBILITY

We are here to serve your after-purchase needs. You can read our Monthly Newsletter containing current information about SBSG's products. Our Newsletter is free to our customers and is available at a minimal cost to anyone interested in Microcomputers **or** call SBSG directly for Programming and Accounting Support. We have 8 incoming lines **or** call our COMM: Micronet Bulletin Board: ID # 70319236; FORUM-80™: (617) 692-3973; MouseNet™: (617) 692-8121; The Source: #TCC 413.

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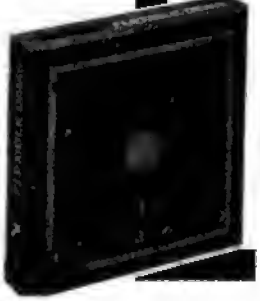

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HOW IT WORKS . . . .

VERSAPAYROLL is a complete menu driven payroll system that grows as you or your business grows. Your VERSA-PAYROLL acts as a simple payroll system keeping track of all government required payroll information. Just enter the employees, VERSAPAYROLL will perform all the necessary payroll calculations automatically and display to totals on your screen. The user has complete control to accept the totals, to print or not print out a check and to post or not post the total to our **VERSALEDGER** system.

- VERSAPAYROLL automatically prints out your PAYROLL checks. **(IF YOU WANT IT TO)**
- VERSAPAYROLL allows you to override any payroll deduction. **(IF YOU WANT IT TO)**
- VERSAPAYROLL automatically posts all checks written to our VERSALEDGER system. **(IF YOU WANT IT TO)**
- VERSAPAYROLL allows the user to print out PAYROLL checks one at a time. **(IF YOU WANT IT TO)**
- VERSAPAYROLL allows the user to print out all your PAYROLL checks at the same time. **(IF YOU WANT IT TO)**
- VERSAPAYROLL gives you a summary of any employee's year to date payroll totals or all employee totals at any time. **(IF YOU WANT IT TO)**
- VERSAPAYROLL will allow you to correct any error made at any time and automatically refigure all totals. **(IF YOU WANT IT TO)**
- VERSAPAYROLL works in every state. **(IF YOU WANT IT TO)**
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- VERSAPAYROLL allows for all of the standard deductions plus state, city and three miscellaneous deductions. **(IF YOU WANT IT TO)**
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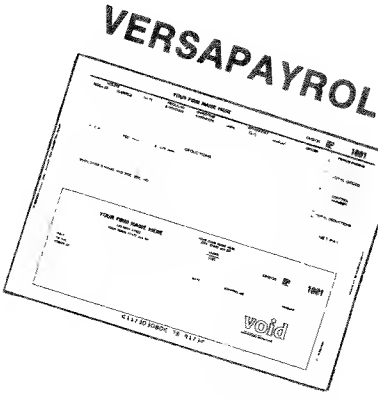

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Can handle up to 300 employees on a TRS-80 MODEL I, 600 employees on a TRS-80 MODEL III, 1200 employees on a TRS-80 MODEL II, 500 employees on an APPLE II, 600 employees on any single density 8" CP/M computer and almost unlimited capacity on hard disk systems.

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HOW IT WORKS . . . .

VERSAINVENTORY is a complete menu driven inventory control system. It keeps track of all information related to how many of a particular item you have. It prints all necessary inventory reports and gives you instant access to any inventory item. VERSAINVENTORY allows the user to stay in touch with items that directly affect sales. Update INVENTORY through easy MENU driven processes.

- VERSAINVENTORY allows the user to instantly add to or deduct from INVENTORY. **(IF YOU WANT IT TO)**
- VERSAINVENTORY handles reorder point levels. **(IF YOU WANT IT TO)**
- VERSAINVENTORY gives period-to-date and year-to-date sales reports. **(IF YOU WANT IT TO)**
- VERSAINVENTORY can be linked to VERSARECEIVABLES and VERSALEDGER. **(IF YOU WANT IT TO)**
- VERSAINVENTORY gives all standard INVENTORY REPORTS. **(IF YOU WANT IT TO)**
- VERSAINVENTORY instantly values your INVENTORY. **(IF YOU WANT IT TO)**
- VERSAINVENTORY HAS AN ALMOST UNLIMITED CAPACITY . . . . .

INTRODUCTORY PRICE
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To figure out estimated VERSAINVENTORY limitations, just multiply 8 by the number of kilobytes of disk storage available. For example, the store capacity on a TRS-80 MODEL II disk drive is 500K. That will allow the user to have about 4,000 inventory items on record. This total is an estimate and depends on how you set up your inventory system.

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	NAME	DESCRIPTION
1	RULE78	Interest Apportionment by Rule of the 78's
2	ANNU1	Annuity computation program
3	DATE	Time between dates
4	DAYYEAR	Day of year a particular date falls on
5	LEASEINT	Interest rate on lease
6	BREAKEVN	Breakeven analysis
7	DEPRSL	Straightline depreciation
8	DEPRSY	Sum of the digits depreciation
9	DEPRDB	Declining balance depreciation
10	DEPRDDB	Double declining balance depreciation
11	TAXDEP	Cash flow vs. depreciation tables
12	CHECK2	Prints NEBS checks along with daily register
13	CHECKBK1	Checkbook maintenance program
14	MORTGAGE/A	Mortgage amortization table
15	MULTMON	Computes time needed for money to double, triple, etc.
16	SALVAGE	Determines salvage value of an investment
17	RRVARIN	Rate of return on investment with variable inflows
18	RRCONST	Rate of return on investment with constant inflows
19	EFFECT	Effective interest rate of a loan
20	FVAL	Future value of an investment (compound interest)
21	PVAL	Present value of a future amount
22	LOANPAY	Amount of payment on a loan
23	REGWITH	Equal withdrawals from investment to leave 0 over
24	SIMPDISK	Simple discount analysis
25	DATEVAL	Equivalent & nonequivalent dated values for oblig.
26	ANNUDEF	Present value of deferred annuities
27	MARKUP	% Markup analysis for items
28	SINKFUND	Sinking fund amortization program
29	BONDVAL	Value of a bond
30	DEPLETE	Depletion analysis
31	BLACKSH	Black Scholes options analysis
32	STOCVAL1	Expected return on stock via discounts dividends
33	WARVAL	Value of a warrant
34	BONDVAL2	Value of a bond
35	EPSEST	Estimate of future earnings per share for company
36	BETAALPH	Computes alpha and beta variables for stock
37	SHARPE1	Portfolio selection model-i.e. what stocks to hold
38	OPTWRITE	Option writing computations
39	RTVAL	Value of a right
40	EXPVAL	Expected value analysis
41	BAYES	Bayesian decisions
42	VALPRINF	Value of perfect information
43	VALADINF	Value of additional information
44	UTILITY	Derives utility function
45	SIMPLEX	Linear programming solution by simplex method
46	TRANS	Transportation method for linear programming
47	EOQ	Economic order quantity inventory model
48	QUEUE1	Single server queueing (waiting line) model
49	CVP	Cost-volume-profit analysis
50	CONDPROF	Conditional profit tables
51	OPTLOSS	Opportunity loss tables
52	FQUOQ	Fixed quantity economic order quantity model
53	FQEOWSH	As above but with shortages permitted
54	FQEOQPB	As above but with quantity price breaks
55	QUEUECB	Cost-benefit waiting line analysis
56	NCFANAL	Net cash-flow analysis for simple investment
57	PROFIND	Profitability index of a project
58	CAP1	Cap. Asset Pr. Model analysis of project
59	WACC	Weighted average cost of capital
60	COMPBAL	True rate on loan with compensating bal. required
61	DISCBAL	True rate on discounted loan
62	MERGANAL	Merger analysis computations
63	FINRAT	Financial ratios for a firm
64	NPV	Net present value of project
65	PRINDLAS	Laspeyres price index
66	PRINDPA	Paasche price index
67	SEASIND	Constructs seasonal quantity indices for company
68	TIMETR	Time series analysis linear trend
69	TIMEMOV	Time series analysis moving average trend
70	FUPRINF	Future price estimation with inflation
71	MAILPAC	Mailing list system
72	LETWRT	Letter writing system-links with MAILPAC
73	SORT3	Sorts list of names
74	LABEL1	Shipping label maker
75	LABEL2	Name label maker
76	BUSBUD	DOME business bookkeeping system
77	TIMECLCK	Computes weeks total hours from timeclock info.
78	ACCTPAY	In memory accounts payable system-storage permitted
79	INVOICE	Generate invoice on screen and print on printer
80	INVENT2	In memory inventory control system
81	TELDIR	Computerized telephone directory
82	TIMUSAN	Time use analysis
83	ASSIGN	Use of assignment algorithm for optimal job assign.
84	ACCTREC	In memory accounts receivable system-storage ok
85	TERMSPAY	Compares 3 methods of repayment of loans
86	PAYNET	Computes gross pay required for given net
87	SELLPR	Computes selling price for given after tax amount
88	ARBCOMP	Arbitrage computations
89	DEPRSF	Sinking fund depreciation
90	UPSZONE	Finds UPS zones from zip code
91	ENVELOPE	Types envelope including return address
92	AUTOEXP	Automobile expense analysis
93	INSFILE	Insurance policy file
94	PAYROLL2	In memory payroll system
95	DILANAL	Dilution analysis
96	LOANAFFD	Loan amount a borrower can afford
97	RENTPRCH	Purchase price for rental property
98	SALELEAS	Sale-leaseback analysis
99	RRCONVBD	Investor's rate of return on convertable bond
100	PORTVAL9	Stock market portfolio storage-valuation program

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  - self-test
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